THE BALTIMORE APPLICATIONS PROJECT:
A NEW LOOK AT TECHNOLOGY TRANSFER

REPORT OF A PANEL

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Foreword

Since 1962 the National Aeronautics and Space Administration (NASA) has undertaken a conscious, organized effort--unequalled by any other federal agency--to facilitate wider use of NASA-developed technology by industry and other federal, state, or local government organizations. This effort has been described variously as technology utilization, technology application, or technology transfer. Other organizations have followed NASA's lead as more public leaders have become interested in exploring how Federally-sponsored research and technology might be tapped for programs and purposes other than those for which it was originally undertaken. The public investment is considerable, and logic suggests that a reasonable effort should be made to maximize its use.

It was in this setting that the Academy was asked by senior officials at NASA's Goddard Space Flight Center to establish a panel to review the Goddard-Baltimore Applications Project in order to describe and to evaluate its achievements, to judge its impact, and to assess its applicability elsewhere. Most of the data was collected by personal interview of those officials and others involved in one or more tasks undertaken through the Project; thus the basic information tends to be subjective and somewhat fragmented. In spite of this, the panel believes it had sufficient access to understand the nature and operation of the Project and the essence of its accomplishments.

One cannot help but be impressed with the Baltimore Applications Project as an example of how good technical assistance can be delivered.

There is much to be learned from this experiment for all kinds of technical assistance projects, from level to level of government.

The report leaves a number of tantalizing questions unanswered: What is NASA's role for technology transfer to local governments in the future? Should liaison be established with Public Technology, Incorporated and NSF-supported projects? How can such experiments receive wide publicity and opportunity for application elsewhere? How does "user pull" strategy fit with other transfer strategies? Is there a central coordinating role to be played in Federal technology transfer efforts? The panel chose not to deal with these broader, comparative questions due to the specific nature of the task assigned to them and the pragmatic limits imposed by time and resources available. They merit close attention in the future.

The Academy is indebted to the panel members for their considerable dedication to this task, as well as to the many officials at the Goddard Space Flight Center, the City of Baltimore, and other professionals connected with the Project who generously made time and information available to the panel.

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Highlights

The Baltimore Applications Project was undertaken by the Goddard Space Flight Center as an experiment in technology transfer--a phenomenon in which Goddard's parent, the National Aeronautics and Space Administration, has had a continuing interest since its establishment by the Space Act of 1958. The project has several characteristics which, in combination, are unique, thereby providing a valuable means for more fully understanding technology transfer and opportunities. First, unlike much technology utilization or applications effort, this project was initiated by the "user"--Baltimore City officials. Second, it is based upon a bilateral agreement between the City and the Center which clearly provides for institutional support from Goddard to back up its technology transfer agent. Third, the project is free-standing, the terms being established by the City and the Center with no formal tie to other technology transfer or utilization systems--i.e. the project has been unhindered in making whatever linkages seem appropriate.

Much like NASA's cooperative international projects, the Baltimore Applications Project gives the appearance of NASA providing the predominant amount of resources invested in the effort; yet the City has contributed considerably through the time of officials involved, and the data/experience from the experiment are equally available to all (as is the case in cooperative space ventures). As Baltimore officials expected to gain access to NASA technology, so Goddard officials expected

to gain experience in working with a different clientele and a different environment for applying technology. Baltimore expected benefit from problem-solving activities; NASA expected benefit from an expanded constituency, having responded to a perceived need (recognized in NASA's charter legislation and reinforced by overt Congressional interest).

Perhaps one of the most salient characteristics of the project has been its focus upon providing practical access to Goddard's technical competence in contrast to an emphasis upon attempts to sell "off the shelf" hardware. This required a considerably different strategy for transfer, emphasizing user-pull rather than the usual technology push.

The achievements of the Baltimore Applications Project (BAP) may be viewed from three perspectives: that of the public at large, of the City of Baltimore, and of Goddard Space Flight Center and NASA. There were at least three benefits to the public at large growing out of the project: (1) valuable insight on how to facilitate user-pull technology transfer; (2) a demonstration of the value, as well as some of the obstacles, in this type of transfer; and (3) guidance for wider application of the technique. The BAP approach resulted in high receptivity to potential technological applications, developed an improved understanding and capacity among city officials for evaluating technology and applications, and cultivated and promoted an improved capability among city officials for linking with technology in future opportunities. Key elements of this approach for application elsewhere are:

-- the predominant initiative should lie with the user community;

-- the technology transfer agent must be closely attuned to user needs and problems, developing considerable personal rapport;

-- the technology transfer agent must have daily access to institutional technical support as well as a wide range of contacts (in and outside that institution);

-- the top management of both organizations (here Baltimore and Goddard) must support the activity, both symbolically and through resource allocation;

-- the technology transfer agent must avoid pushing Federal Agency program objectives or otherwise appear to act as a partisan agent;

-- the technology transfer agent should have frequent access to the top officials using organizations.

Baltimore benefited in four ways from the project: (1) City agencies have developed the capability for the more systematic review and use of technology; (2) some 69 tasks were undertaken between April 1974 and September 1976 involving technological problem identification/solving; (3) both the image and technological self-confidence of the City were improved; and (4) the City's technological sophistication and, subsequently, its access to Federal funds for technology-related programs were enhanced. Most of the tasks (52) involved principally technical consultation--the provision of data, information on techniques, hardware, etc., or providing contacts in other agencies or industry. The demonstration of technology constituted 13 tasks, while actual research and development resulted from four. Since the purpose of the project was to help the City officials in evaluating and using technology,

not to sell them technology, the technology transfer agent frequently was cast in the role of searching out data for the comparison of technological alternatives. Often the result was that a decision was confirmed rather than changed--resulting in "technological assurance"--i.e. officials received data via a third party (the technology agent) that their tentative, unaided choice was "the best". This proved to be only one facet of the "tutoring" function by the technology transfer agent which facilitated noticeable improvement in the capability of the City to deal with technology.

The Goddard Space Flight Center benefited from this project, principally in two ways: (1) by conducting a successful experiment demonstrating user pull technology transfer; and (2) through the project, enhancing the Center's (and NASA's) image in the Baltimore area as well as enlarging its constituency. Goddard did gain some experience and broadened technical competence, but this was not as extensive as originally anticipated, at least partly because of a reluctance among some supervisors to permit their people to participate.

The Baltimore Applications Project was oriented to the process of technology transfer, not to selling Baltimore officials upon the acceptance and use of particular products of technology. Therefore, the project results are principally in terms of changed process, organizational environment, and institutional procedures--not in numbers of specific applications of technology made. However, technical informa-

tion and knowledge was applied, resulting in specific actions or decisions. A great deal has been learned from this experiment, but much remains to be learned and can be if it is continued.

The Panel makes two recommendations which it believes can lead to an improved, more valuable Baltimore Applications Project and enhance the successful transfer of NASA (and other Federally-developed) technology.

First, the project should be continued for two more years; second, a limited extension of the project (as an experiment) should be tried at another location. Because a good many of the tasks undertaken have yet to be completed, only fragmentary data has been available to assess the impact of those tasks. Also, the Panel believes that several modifications can be made in the BAP operation that will provide valuable experience and further data by which to more fully evaluate the success of the user-pull strategy. These include a more determined effort to raise awareness of the project at Goddard and in Baltimore; greater effort to identify NASA technology applicable to Baltimore problems; taking a less conservative stance about involvement in the implementation stage of tasks and in withholding assistance when commercial sources are thought to be available; and sharing of the technology transfer agent's costs.

Extending the experiment to another location is necessary in order to determine if the success in Baltimore is due to the strategy and execution of the particular approach or because of factors peculiar

to Baltimore itself. Such a second experiment should be undertaken only by request of a potential user, and should be carefully instrumented to provide fullest possible data.

The Baltimore Applications Project has been an unqualified success in meeting the objectives originally laid out for the project. It has made a substantial contribution to a more thorough understanding of the technology transfer process. Like any experiment, it also has opened new questions and avenues worthy of exploration.

Chapter I

Introduction

> Why hasn't our national technical capability, applied so successfully in the space and defense areas, been applied equally successfully to a multitude of local government problems? 1/

The Significance of the Baltimore Applications Project

The attempt to bring the technological competence of Federal research and development programs to bear upon urban problems involves at the least, three challenges: (1) the "secondary" use of Federally-funded research and development, (2) the translation or adaptation of this technology to problems in the cities, and (3) discovering inter-organizational relationships/mechanisms to make such transplants succeed. Quite apart from its statutory responsibility to make the results of aeronautics and space research widely available, NASA has long recognized the utility of secondary use of the research and development for which it is responsible. This recognition has spread to other Federal agencies.

> During the past few years there has been a growing interest in the secondary use of research and development output. If the output from a research and development effort, over and beyond its initial specific mission, can provide technology that is productively used in many locations and/or by a number of organizations, then the original cost of the research can be viewed as providing a substantial contribution over and above its primary task to satisfy a specific and defined need. Secondary utilization of research and development has attracted attention of . . . [the highest government officials] as a logical

1/ The Urban Institute, The Struggle to Bring Technology to Cities, Washington, D.C., 1971, page 5.

method of enhancing the productive output of research and development efforts. 2/

The second challenge, that of translating Federal technology to useful applications in cities, has proved to be a formidable task. The assumption is that cities have been using outmoded technology when adaptation of existing technology might produce significant economic savings and/or increase the quality of life. It is further asserted that the necessary technology already exists, that the technological community has the know-how to make whatever adaptations are necessary, and that industry is eager to participate. These assertions remain largely unvalidated and the barriers to such transfers between cities, industry, and technology are recognized to be formidable. 3/

Lambright and Teich have reviewed a number of attempts to transfer technology to the urban setting, concluding that the results, particularly those attempts to transfer high technology originating in Federal laboratories (such as space, atomic energy, and defense) to city users who are accustomed to less advanced technologies, generally have been disappointing. A key difficulty has been that of forming the necessary interorganizational links. They conclude that "what is needed is a coalition behind a transfer--an administrative 'delivery system'--that includes the lab (innovator), a manufacturer, and a user." 4/ In

2/ J.A. Jolly, and J.W. Creighton (eds.), Technology Transfer in Research and Development, Naval Post-Graduate School, Monterey, California, 1975.

3/ Urban Institute, Op.Cit.

4/ W. Henry Lambright and Albert H. Teich, "Technology Transfer as a Problem in Interorganizational Relationships", Administration and Society, Vol. VIII, No. 1 (May 1976) pp. 29-54.

essence, what Lambright and Teich are saying is that success in the transfer of high technology to urban problems is more dependent upon the process by which this transfer is attempted than upon the technology involved.

The Baltimore Applications Project is particularly significant because, even as an experiment, it represents a distinct departure from NASA's previous approaches to the transfer of technology by its Technology Utilization Program (TU Program) which has been an important institutional activity since the early 1960s. The TU Program has been directed principally toward secondary applications of existing NASA technology. From the beginning, the modus operandi of the Baltimore Applications Project has been to have local officials define their problems, with the NASA technological agent acting as "consultant" or information link to technical competences in the NASA laboratory, not necessarily to NASA technology already developed.* This experiment is impressive because: (1) it offers an unusual contribution to the general body of knowledge concerning technology transfer, (2) it provides an extraordinary learning vehicle for NASA in the assessment and design of future applications projects, and (3) it has been an excellent learning vehicle for Baltimore.

The panel is especially impressed because NASA has been a leader in the attempt to develop successful modes to transfer technology, and this

* Other NASA Centers have provided personnel to state or local governments as transfer agents. For example, the Kennedy Space Center made an official available to the Illinois State Budget Office, so the BAP experiment is not totally sui generis. See testimony of Edward Z. Gray, Assistant Administrator for Industrial Affairs and Technology Utilization, NASA, Technology Utilization, Hearings, Subcommittee on Aerospace Technology and National Needs, U.S. Senate, 94/2, Sept. 22,23,24, 1975, pp. 454-463.

experiment is particularly challenging since there are few, if any, precedents upon which it can draw. The non-advocacy, diplomatic, and facilitative features of the Baltimore Applications Project have been apparent to the panel. The low-key problem-oriented approach for transferring technological ideas is a distinctive departure from the more publcized, glamorous, "hawking" approaches. Goddard and NASA are to be commended for this innovative and apparently successful strategy.

The Task Placed Before the Panel

The task which the panel has been asked to address is " . . . to conduct an evaluation of the NASA/Baltimore Applications Project for the Director, Goddard Space Flight Center (GSFC). The purposes of the evaluation are five fold. They are to: (1) provide an independent and objective evaluation of the achievements of the NASA/Baltimore Applications Project; (2) determine the extent to which the project's objectives have been accomplished; (3) analyze and describe how the project worked; (4) assess its applicability for a further period of time in Baltimore, and its extension elsewhere; and (5) evaluate its impact both upon the City of Baltimore and the Goddard Space Flight Center."

The principal thrust of the review has been to treat the BAP as a true experiment, and to systematically describe and analyze what has been learned from approximately 30 months of operation. Emphasis has been placed on judging the extent to which it has been successful in demonstrating a particular mode of technology transfer with subsequent

application and the extent to which such a mode of operation might be applicable elsewhere.

In undertaking its review, the panel has followed the process common to most Academy panel studies whereby the panel sets the study objectives, providing clear guidance to staff for collecting data, preparing summary materials, and drafting working papers. The report represents the consensus of the panel with respect to findings and recommendations.

Chapter II

Laying the Foundation for the Baltimore Applications Project

The headline in the New York Times read "NASA Consultant to the City is Finding Down-to-Earth Uses for Space Technology." 1/ It was this article that sparked interest within the Baltimore City Hall, ultimately leading to the establishment of the Goddard/Baltimore Applications Project. Mr. Robert C. Embry, Jr., Commissioner of the Baltimore Department of Housing and Community Development, wrote to NASA Administrator Dr. James C. Fletcher, "We read with great interest of NASA's relationship to New York City as explained in the Times of October 13, 1973. Baltimore would very much like to participate in such a program having a similar person assigned to work with us. Would you please indicate who we might speak with to work out the details of such a program?" 2/ In just over seven months, the Baltimore Applications Project came into being with the ceremonial signing of a Memorandum of Understanding on April 26, 1974 in Baltimore's City Hall.

Within two weeks, then Congressman Paul Sarbanes of Baltimore had followed up Embry's initial letter with one of his own "urging prompt response" to the Baltimore request. On November 21, Edward Gray, Assistant Administrator for Industry Affairs and Technology Utilization, gave a positive response to Embry's inquiry, requesting that he contact Mr. Jeffery Hamilton of the Technology Utilization Office, NASA Headquarters, for a more detailed discussion of the possibilities. Hamilton called the

1/ New York Times, October 13, 1973.

2/ Letter to R.C. Embry, Jr., to James C. Fletcher, October 16, 1973.

Deputy Director of the Goddard Space Flight Center, Donald P. Hearth, describing the Baltimore request and soliciting Goddard's interest in participating in an arrangement similar to that with New York City. Hearth asked Charles Boyle, Chief of the Special Projects Office, to pursue this idea further with Hamilton before any commitment was made.

By early December the Center's leadership decided to participate, and the Center was represented at the first meeting of city and NASA representatives on December 11, 1973. The meeting was held at the Goddard Space Flight Center with senior Baltimore officials Robert Embry, Pierce F. Linaweaver, Director of the Department of Public Works, and Larry Reich, Director of Planning. The principal consideration was how a mutually satisfactory arrangement could be worked out. Enthusiasm was high on both sides. Negotiations from the NASA side were being conducted principally by representatives from the Technology Utilization function--both in NASA Headquarters and at the Goddard Space Flight Center. A second meeting was held, this time in Baltimore, on January 21, 1974 when Mayor William Donald Schaefer attended, accompanied by five department heads. Embry continued to be the principal negotiator for Baltimore. There was a general discussion of the possible relationships between Goddard and Baltimore, a review of typical city problems, and a general agreement that NASA should draft a Memorandum of Understanding and begin the process of selecting potential candidates to act as the Goddard representatives in Baltimore. Donald Friedman and Charles Boyle of Goddard met with Embry, tentatively agreeing that the "technology

transfer agent" should be provided by NASA, with NASA paying the agent's salary, that he should serve in the Mayor's Office, with Baltimore providing office space and necessary supporting services. Following the meeting, Mayor Schaefer wrote to Hearth expressing his satisfaction with the meeting and pledging his continued support to the proposed project.

Toward the end of the month Jack Peake, chief of the Office of National Needs, was assigned by Hearth to work with Boyle to organize the project and select the director. During the next two months they drafted the Memorandum of Understanding for review by NASA and Baltimore officials. The selection process formally began with a memorandum from Hearth to all Goddard directors on March 13, 1974 requesting their nominations of candidates for the position. The final selection of the director, Tom Golden, was made shortly before the final acceptance of the Memorandum of Understanding. The signing ceremony/press conference was held in Baltimore on April 26, 1974. Dr. John F. Clark, Director, signed for GSFC.

There were several circumstances which gave positive impetus to the birth of the Baltimore Applications Project. First, NASA Headquarters encouraged the Center to participate in this project--without placing any constraints upon how the Center might proceed. From the outset the Center was free to accept or to reject the idea of participating at all. Second, the Administrator of NASA had been encouraging a "technological outreach" of this nature. Just four days before the signing of the Memorandum of Understanding, on April 22, 1974, the

Administrator sent a memorandum to the Directors of all NASA Field Centers emphasizing the desirability of applying NASA's skills to national needs. In addition, the Center leadership provided considerable positive interest and support throughout the working levels at Goddard for undertaking this project. There was recognition that this project represented something of a "risk" since it was not closely related to NASA's fundamental space mission and, therefore, was viewed in some mid-management quarters as a "competitor" for technical manpower and financial resources. Even a small incursion on primary resources was viewed by some as undesirable because Goddard (like most other NASA Centers) had been living for five or six years with tight personnel ceilings--indeed, constant attrition accompanied by occasional reducations in force. However, these reservations were not serious enough to prevent the initiation of the project.

Finally, one cannot overlook the significance of the close relationship between Hearth and Peake during the formative period of the BAP. Peake had responsibility for the BAP within his Office of National Needs; Hearth as Deputy Center Director, represented top management and was solidly behind the project. Close daily contact provided an informal opportunity to discuss virtually every aspect of the project, including its concept, organization, staffing, and other relationships from the planning stage through most of the first 18 months of operation.

Goals of the Baltimore Applications Project

The goals enunciated for the project in the Memorandum of Understanding are clear, though general. The memorandum states"

> It is the policy of the National Aeronautics and Space Administration to encourage cooperative projects as a means of facilitating and accelerating the transfer of aerospace technology to public sector areas of concern.
>
> Cooperating with the City of Baltimore, NASA agrees to undertake a pilot project of an initial two-year duration to test the feasibility and measure the effects of utilizing technology in the solutions to problems that affect the urban environment, generally, and the challenge to public administrators of Baltimore, specifically. 3/

Perhaps more incisive insight into the goals of the BAP is evident in the attitudes and expectations of those officials principally involved in establishing the experiment--both at the Goddard Space Flight Center and in the City of Baltimore. Donald Hearth, who was Deputy Director at Goddard during the inception and early operation of the BAP, was the principal policy official responsible for setting the tone for the experiment, what should be accomplished, and the means by which those goals should be approached. Hearth had four deeply held convictions which generated considerable support for this activity and affected the fundamental concepts underlying the BAP. These were: (1) technology can be an asset in dealing with many of society's problems, including urban problems; (2) NASA, as an institution, is unique in the Federal government since it has ten laboratories throughout the country con-

3/ Basic Memorandum of Understanding, April 26, 1974. See Appendix B. A subsequent, more detailed Memorandum of Understanding, which was completed on October 18, 1974, cites subsection 203 (b) of National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. 247 (b) as the authority for establishing the BAP.

stituting unusual talent pools of highly qualified technical and management people; (3) NASA researchers and technologists are also public servants, but more perceive themselves as scientists or engineers, not as public servants; and (4) there is a great communications or perception problem both within NASA and outside in the sense that there is a failure to understand that NASA's responsibilities go beyond aerospace and that the public has an inadequate understanding of how NASA works or the nature of its talent pool. 4/

Hearth was explicitly clear about the fundamental concept for the BAP, and he communicated this unmistakably to those at Goddard assigned to organize the project. In his view, the idea from the beginning was to experiment with how to transfer technology--not how to sell it--with the principal emphasis upon having Goddard act as a technical resource for the City of Baltimore. Those involved in initiating the project were aware of similar efforts on the part of the National Science Foundation and of Public Technology Incorporated, but they believed that the BAP represented a different mode for technology transfer which merited testing. [In fact, the BAP did represent a new mode, which in a somewhat different context, was about to be tested by Public Technology Incorporated through a new program sponsored by the National Science Foundation. This new program, named the Urban Technology System, was also experimental, aimed at placing over two dozen "technology agents" in cities of various sizes throughout the United States. The UTS Program

4/ From the discussion at the first panel meeting, July 26, 1976 at the Goddard Space Flight Center. It should be noted that Donald Hearth moved from GSFC to become the Director, NASA Langley Research Center in December, 1975.

was just starting, shortly after the Memorandum of Understanding was signed between GSFC and the City of Baltimore.] Hearth viewed the BAP as supplemental to NASA's long standing technology utilization efforts, not competitive with it.

Hearth's view on the underpinning philosophy of the BAP was faithfully reflected in the day-to-day project development of activities undertaken by Jack Peake and Charles Boyle. As they talked about the nature of the qualifications for the project director, and later conducted extensive interviews with potential candidates, the concept was fleshed out. The approach was to be premised on the general method of "technology pull" from Baltimore to NASA, where mutual trust and understanding were to be developed between the technical agent (that is, the BAP project director) and working officials in the City of Baltimore who would identify their particular problems, then cooperatively search for possible alternative solutions. The choice of technology which might be applied was to be the city official's choice and the problems were those of the particular department or agencies involved. This meant that the technology agent was to be more of a coordinator or facilitator than a typical project director, i.e. he was to be a technological resource and not a manager or implementor of technology. Although specific applications of technology (and hopefully some applications of aerospace technology) were expected, these were not to be the principal objectives of the project. Rather, BAP was viewed more as an experiment or demonstration project by which to determine if a city could use the technology agent in the role of a "technologist in residence."

The project's originators at Goddard were convinced, based upon their own observations of the transfer process, as well as extensive discussions with others, that this experiment should test, in a limited environment, the value of "technology pull" in contrast to the more frequently used "technology push."* The process of application was never intended to be limited to that which originated only in NASA or the aerospace industry.

> A prime objective of the Baltimore Applications Project is the determination of how technology can be utilized in helping the departments in the City of Baltimore to more efficiently, effectively and beneficially carryout their tasks. 5/

Quite apart from learning about a different process for technology application, the project originators did expect some benefits to flow to Goddard and to NASA. For example, it was expected that the involvement of GSFC personnel in this project would given them an additional "sense of accomplishment", and that it might also improve the technological versatility of those who participated. Although the BAP was not a conscious effort to diversify Goddard's project activity, it might serve in a small way, as an example of the potential opportunities in the expanded use of technology which were postulated to exist. In addition, it was anticipated that Goddard, as an institution, would become better known in Baltimore and its environs because of this direct public service. Also, it should provide a number of new linkages outside the traditional

5/ Tom Golden, Second Quarterly Progress Report, January, 1975.

* "Technology pull" is commonly used to describe customer or potential user demand for new technological solutions; "technology push" describes the phenomemon where the principal actor is the technology discoverer (or a third party) who has the technology in hand and presses for its use.

aerospace community, and Goddard personnel could expand their technical perspectives from their experiences in dealing with specific problems in Baltimore.

Baltimore officials who helped give birth to the BAP or who were among the first to have considerable contact with the technology agent (Tom Golden) in suggesting tasks which might be undertaken, had similar perceptions or expectations about the project. In their view, the purpose was to help the city address some of its problems through improved and/or expanded application of technology (again not limited to NASA or aerospace technology). The technology agent was conceived of as a modern day "county extension agent" who was a technologist with his fingers on research and development across the Federal government, able and willing to help city officials in diagnosing problems and sorting out technology which might be applicable. Both parties anticipated "practical assistance." The project was considered valuable to NASA as another means of demonstrating the expanded utility of NASA's primary concern--aerospace research and development. 6/

Project Organization and Guidelines

Hearth decided to place the Baltimore Applications Project in Jack Peake's Office of AST/SRT National Needs Office. 7/ Peake's office

6/ From interviews with city officials, July-October, 1976 and from the Second Panel Meeting, September 17, 1976 in Baltimore, Maryland.

7/ The AST refers to Aeronautics and Space Technology, the SRT to Supporting Research and Technology--two categories of "general support" funds which headquarters allocates to NASA Field Centers on a project basis permitting activities on the initiative of the various Centers and their divisions. The Goddard Office of Technology Utilization was located in the Administration and Management Directorate under Special Programs. Later this function was transferred to the Office of AST/SRT National Needs.

was located in the Engineering Directorate which has jurisdiction over the largest number (and perhaps the greatest variety) of engineers at the Center. Hearth reasoned that successful "linking" between NASA technical competence and Baltimore's problems were more likely if the effort was administered from Goddard's principal engineering organization rather than from another location. No written policy was ever issued from the Director's Office to Peake laying out specific responsibilities or authority. Peake and the BAP project director operated, essentially, free from any bureaucratic restraints, reporting progress/problems informally from time to time to Hearth, and issuing quarterly and annual reports to inform Goddard management, Baltimore officials, and other interested parties of progress. [It should be recalled that from the time Peake was first brought into this activity in January, 1974 until Hearth left the Center in December, 1975, they were in continual, if informal, communication.]

The selection of the right kind of individual as project director was viewed as a key to the success of the project. Boyle and Peake labored for the better part of a month in sorting out guidelines for candidate selection and in the actual search and selection process. A two and one half page "job profile" was put together by Boyle and Peake as a basis for directing their search and for evaluating potential candidates. Some of the abilities listed were: analyze/evaluate, organize/set priorities/plan, build relationships/make friendships, convince/persuade, and speak/communicate. Ultimately, the formal position description described the project director's qualifications as:

> The personal qualifications of the incumbent are of paramount importance. He must possess current knowledge of NASA and the federal establishment, general technical skills, active imagination, and natural ability to work cooperatively with Baltimore City officials and citizens in pursuit of project goals. He will interface with city employees of all levels and with various citizens from civic organizations, business and industry. He will meet the public in a variety of settings, including speaking engagements and news interviews. 8/

The initial list of candidates was obtained in three ways. First, Boyle and Peake listed whom they thought might be potential candidates. Second, many heard by word of mouth about the BAP and asked to be considered for the position. Third, Hearth sent a memorandum to all directors at GSFC requesting nominees. Hearth attached to his memorandum a description of the project, its location, the nature of the job, general qualifications, and the assurance that this job would receive continuing top level concern and support . . .

> The job of Director, TTP, is regarded as a developmental career opportunity. The continuing personal interest of the Goddard Deputy Director will help ensure that the necessary administrative and technical support from NASA will be provided whenever problem solution efforts require help from our discipline areas. 9/

Boyle and Peake received nearly 100 names to consider from these various sources. During the preliminary screening process, Peake and Boyle relied principally on personal knowledge of the candidates. They sought qualities of flexibility and adaptability as well as breadth of technical background and experience. They talked with supervisors and

8/ NASA position record number E2292, Goddard Space Flight Center, AST Technology Utilization 770-40, dated May 14, 1974.

9/ Memorandum to all directors [GSFC] from Donald P. Hearth, Deputy Director, Subject: NASA/Baltimore Applications Project, dated March 13, 1974.

peers, consulted personnel folders and came up with approximately a dozen candidates for intensive interview. Interviews were unstructured, but generally encompassed a statement as to what was perceived to be the nature of the requirements of the job, inquiries about the candidates' views of the job, and questions to elicit the nature and/or extent of the candidates' motivation and interest. Peake and Boyle separately rated the candidates on interest, personal traits, technical ability, related experience, and recommendations. They then compared notes and resolved differences in their ratings. The choice was narrowed to six candidates. Special attention was given to the motivation, with the remaining six candidates asked to participate in a structured exercise called SIMA (System for Identification of Motivated Abilities) which provided more objective data for judging motivation. Boyle and Peake ranked the final four candidates, recommending Tom Golden for the job. Hearth concurred, and Tom Golden was appointed as the Director of the Baltimore Applications Project.

As noted above, aside from the Memorandum of Understanding, there was no formal policy or program guidance issued from either the Director's Office at GSFC or from the Office of the Mayor in Baltimore on how the technology agent was to pursue the BAP goals. At Goddard, there was clear, if informal, understanding from Hearth to both Peake and Golden about the nature and modus operandi of the BAP. Golden was to work pragmatically without specific guidelines, keeping Peake and Hearth informed about progress on the project, and avoiding establishing bureaucratic "procedures." Apart from the televised press conference

in the Baltimore City Hall at the time of the signing of the Memorandum of Understanding by the Mayor and the Director of Goddard, there was little overt publicity about the project. Both Goddard and city officials (principally Hearth, Peake, Golden and Berkowitz from Baltimore) concurred that the project should maintain a "low profile" to avoid raising undue expectations early in the project's life and to avoid "over-selling" what might be accomplished. It was believed that this approach would provide greater flexibility for the project at the outset as well as insuring better access to city agencies by Golden, avoiding an appearance that he was expected to be a "technological messiah." Although not shunning publicity, this "low profile" carried several advantages to Goddard: first, avoiding the perception that the Center's principal interest in the project was as a public relations gimmick, and second, not to draw undue attention to a project which fell outside the ambit of Goddard's primary mission of aerospace research and development.

Getting Started

Mr. Bernard Berkowitz, the Mayor's Coordinator for Physical Development, was formally designated as the Baltimore City official to act on behalf of the Mayor in the Baltimore Applications Project. Office space and secretarial support would be provided, facilitating a close working relationship between Golden and Berkowitz. Golden found Berkowitz extraordinarily helpful in introducing him to Baltimore City government. From the beginning, Golden was invited to sit with the Mayor's Cabinet for Physical Development which includes the Departments

of Economic Development, Finance, Housing and Community Development, Planning, Public Works, Recreation and Parks, and Transit and Traffic. In this way Golden was able to keep in close touch with the kind of issues and problems being brought to the attention of the Mayor. It also presented Golden with the opportunity, on a weekly basis, to become more personally familiar with the heads of those departments where he was most likely to be asked for assistance.

Very early in the project Golden and Berkowitz conducted a series of free-ranging discussions from which it became possible to make a conceptual separation of the various organizations in the city into "intensive" and "non-intensive" categories with respect to likely application of NASA technology. The categorization was as follows:

Intensive	Less or Not Intensive
Education	Assessments
Fire	Audits
Health	Comptroller
Hospital	Economic Development
Housing and Community Development	Finance
Planning	Law
Police	Legislative Reference
Public Works	Postmortem Examiners
Recreation and Parks	Real Estate
Transit and Traffic	Social Services
	Treasurer

Golden proceeded to arrange for appointments with the heads of the departments in the "technologically intensive" category. This gave him an opportunity to discuss on an informal basis the nature and goals of the project, how he hoped to operate, and a chance to become better acquainted on a personal basis. It also offered the initial opportunity

to begin exploring the kinds of problems--as seen from the department's viewpoint--which might be considered for possible technological assistance.

> A specific effort was made at each encounter not to suggest in any way that 'NASA has a solution to the problem, so what is your problem'? Only at the end of each encounter was NASA or other Federally sponsored technology mentioned. Literature covering the public-oriented technology programs sponsored by the NASA Technology Utilization Office was left with the Department Head for him to peruse at his leisure. The encounter hopefully left the Department Head with the idea that we are sincerely searching for identification and definition of his problems out of which might come one or more means of solution through NASA know-how. 10/

Golden carefully followed this "low-key" approach in each of his contacts, seeking to leave the impression that his role was to be as a technology resource not as a technology salesman. This was the process used for identifying potential tasks under the project. The Department Head was the key level for determination of what the problems were and the priority in which they should be approached. To the extent that there appeared to be any type of conflict among projects or in priorities between departments, requiring Golden to work more urgently upon one than another, that determination was made in consultation with the Mayor's Coordinator for Physical Development, Bernard Berkowitz. Up to August, 1974, Golden identified 49 different task areas with which Baltimore City officials wished assistance. For each task Golden identified a contact in the Baltimore City government (usually at the bureau chief or higher--i.e. Department--level), and a specific member of the Goddard

10/ Baltimore Applications Project, Interim Progress Report, August, 1974, page 9.

staff responsible for coordinating Goddard participation (or participation by other agencies, as required).

After only three months, Golden began to feel the pressure of dealing with a wide variety of topics, requiring considerable assistance. He noted,

> If effective technology transfer and utilization are to occur a strategy must be determined or regime be established for providing additional participants and adequate time for their participation if we are to work effectively with the . . . Baltimore City counterparts. 11/

This was to be a continuous challenge--developing a broad network of contacts, extending beyond NASA, which could be brought to bear on Baltimore problems. Rarely was there reluctance among Goddard people to take part; and when there was it resulted from conflicting priorities rather than lack of interest.

11/ Ibid. p. 28.

Chapter III

The Baltimore Applications Project in Operation

Not apparent amid the glare of T.V. floodlights illuminating the ceremonial signing of the Memorandum of Understanding were three factors which, for the most part, helped ensure a successful beginning to the Baltimore Applications Project. These were: (1) a congenial environment, (2) a relatively low-risk modus operandi, and (3) optimistic, if somewhat amorphous expectations.

The Environment

The environment surrounding the project was positive. The project enjoyed top-level support both in Baltimore and at Goddard; it reflected a positive "image" as representative of NASA, and it found unusual receptivity in Baltimore. First, the Mayor of Baltimore, William Donald Schaefer, was convinced that the BAP could do many good things for the City of Baltimore; this was reinforced by the strong encouragement of one of his principal cabinet members Robert Embry, Commissioner for Housing and Community Development. The Mayor assigned one of his top assistants, Bernard Berkowitz, Physical Development Coordinator, as the Baltimore City official responsible for the project. The selection of Berkowitz was especially fortuitous since he was politically knowledgeable and professionally respected, providing an ideal "buffer" between the technology agent (Golden) and the top political level, without inhibiting the communications. The Director

of Goddard, Dr. John Clark, strongly supported the BAP as an experiment; he was seconded by his Deputy, Donald Hearth, who had a strong interest in seeing the project succeed and who was prepared to exercise the authority of the Director's office to encourage support and cooperation throughout the Center. The close, informal, relationship between Hearth and Jack Peake's office, where the Goddard responsibility for BAP resided, was continuously reinforced. Finally, in selecting Tom Golden as the first technology agent to conduct the BAP, they had selected an individual of unusual sensitivity, ready and able to develop rapport and to reflect the technical competence of Goddard in a fashion inviting positive response.

Second, NASA enjoyed the image of a successful, well-managed, high technology agency, with an outstanding record of achievement. In addition, it was a "neutral" agency since it sponsored no programs and did not enforce any regulations having significant impact (at least of a direct nature) upon cities. In this operational sense, Baltimore officials had little knowledge about NASA (or Goddard) except what they read in the newspapers, and their brief exposure in developing the Memorandum of Understanding. The image with which the BAP "opened for business" was a positive, successful one.

Third, apart from all else, there was a favorable receptivity to the BAP in Baltimore. Baltimore had something of a "heritage" for technical and other innovations throughout its history. For example, it established the first Department of Public Health in the United States

in 1793; the first gaslight used to light either a room or street corner was located in Baltimore in 1802; it was the site of the first steam car (1830) and the first direct, transatlantic steamship service (1838); it had the first College of Dental Surgery (1839), and was the origin of the first successful demonstration of the telegraph (1844); it also pioneered in electric street cars (1885) and has been recognized for more than 75 years as a leader in the planning and operation of municipal water services. A half dozen of the Mayor's key cabinet members were involved in the discussions leading to the Memorandum of Understanding; and several of these, prior to the signing of the Memorandum, had already begun considering possible tasks to bring before the technology agent upon his arrivial in Baltimore.

BAP Modus Operandi

It was more or less agreed among Hearth, Peake, and Golden that Golden would follow a relatively simple four-step approach in working on the various tasks that came before the Baltimore Applications Project. He would depend upon city officials to identify <u>their</u> problems, would search for additional data to better illuminate the problem or potential solutions, screen irrelevant bits and pieces, aggregate data in a form suitable for his clients, and continue whatever assistance proved necessary, as requested, until the task was completed or dropped. With each of these steps, Golden was guided by a series of deeply held but informal operating rules. In searching out the problems, he was to keep a low

profile, avoiding "political" problems, particularly during the initial period of the project. In searching for more data on the problems/solutions he was to use every resource possible, making it clear to those with whom he worked in Baltimore that the BAP was not to be limited to the NASA technology competence.* In screening the resulting feedback data, and either presenting it or arranging for presentation to appropriate officials, Golden was to avoid pressing for particular solutions. He was careful to avoid NASA (or other governmental) competition with commercial sources so that when a particular service or piece of hardward was "commercially available" he tended to withdraw from further active participation in the task. Finally, after presenting the information for possible management decision, he bowed out of the picture unless requested to remain--retaining a low, unobtrusive profile and studiously staying out of the "decision-making" chain.

Expectations

From Baltimore's viewpoint, NASA technology (as represented by the BAP) was welcomed with open arms. It was anticipated that NASA could help by applying its "space age" technology. Presumably, the city would be better off for it, becoming a more efficient, effective city because of NASA applications. There was also some belief extant

* To some extent it might be considered presumptive of NASA to act as general interpreter to Baltimore for all Federal technology, but this was the role played by Golden. NASA does have a primary (and explicit) charge for technology transfer in the Space Act of 1958, Section 203 (a) (3). NASA's Regional Dissemination Centers have access to most Federally-sponsored technology, with NASA constituting only 30 per cent of their files.

among officialdom that active participation in the BAP would be further demonstration of the "progressiveness" of Baltimore. From the Goddard viewpoint, NASA officials anticipated a series of opportunities for Goddard technological competence to be brought to bear, bringing favorable recognition (perhaps some newsworthy publicity) as well as the benefits from having a number of its scientists and engineers participate actively in the solution of city problems (giving them some social visibility, acclaim, and technical stimulation).

All of these things augured well for a most successful project, benefiting both the City of Baltimore and the Goddard Space Flight Center.

Summary of Tasks Undertaken

During the nearly 30 months from the signing of the Memorandum of Understanding (April 1974) to the 1976 Fall Progress Report, 69 tasks have been activated under the Baltimore Applications Project.[12/] Sixteen different departments or agencies in Baltimore have been involved in one or more tasks, ranging up to 22 different taks in which the Department of Public Works has participated. See Appendix C. As might be expected, enthusiasm for the project is closely related to the depth of involvement an agency, and its officials have had with the BAP. Most officials of the Baltimore Department of Public Works who were interviewed praised Golden and the BAP, and gave strong support for the continuation of the project.

12/ This is at least a close approximation. The best sources for identifying tasks are the Interim of Annual Reports; however, tasks may be merged from one reporting period to another, dropped without further comment, or recast.

Early in the project, Golden categorized tasks according to three types of activity: (1) consultation and advisory, (2) technology demonstrations, and (3) research and development programs. The first category described those tasks involving data collection, synthesis or some analysis, identifying sources of advice or assistance, and providing advice. The second category covers actual demonstrations of technology--whether of a short "show and tell" variety or a longer duration experimental use of some technology. The third category was reserved for those tasks that required laboratory work, perhaps of up to a year's duration. Of the 69 tasks, 52 can be classified as advisory or consultative in nature, 14 were wholly or at least partly technology demonstrations, and four were principally research and development tasks. For example, the high temperature paint task involved putting appropriate Public Works officials in touch with a Goddard engineer who advised them on available specialty paints for high temperature application. Once the information was made available, the BAP task was completed and the Department proceeded to obtain the paint and use it satisfactorily.

The "Probeye" and "air breathing apparatus" tasks exemplify technology demonstration of the "show and tell" variety. Golden arranged, through NASA Technology Utilization channels, for manufacturers of these new equipments to conduct demonstrations for Fire Department personnel at a convenient time and place so they could receive instructions and actually handle the equipment. Once the demonstrations took place, Golden and the BAP bowed out. A different example of technology demonstration

was a series of tests, on cement mixers and salt spreaders, of a corrosion resistant zinc-based paint provided by GSFC for test use by the Department of Public Works. The paint was applied and an evaluation is in process.

An example of an R&D task is that of heavy metals detection to monitor their relative concentration in water. After some searching, it was determined that current instrumentation is inadequate; a Goddard researcher, pursuing research relevant to solar and astrophysics, began doing applied work which should yield new instruments capable of detecting minute traces of heavy metals on a continuous basis.

Of the 47 tasks considered "completed," the vast majority--39--fall in the "advisory and consultative"category, six in technology demonstration, and two in research and development. This should not be surprising given the nature and goals of the BAP--to respond to technological needs as determined by city officials, and to provide a source of technological competence.

About half of the tasks have involved NASA technology and Goddard personnel other than those directly responsible for the BAP. This is an unusually high proportion given the fact that information was sought wherever it might be for problems defined by city officials.

Mini-Cases--How the BAP Actually Worked

Since it was not possible to explore in detail all 69 tasks, five were selected for examination in depth to illuminate the nature of

involvement, both in Baltimore and at Goddard, and to illustrate the considerable serendipity which operated in this experiment of "user-pull" process.* Each of the mini-cases is more fully described in Appendix D.

Very early in the life of the BAP, Golden was asked to investigate how "waste heat" at the city incinerators might be recovered for secondary use. Goddard had conducted a number of successful applications in heat pipe technology for balancing heat loads in spacecraft, and numerous other applications had been made of the technology. Golden therefore asked those involved at the Goddard Facilities Engineering Division to take the leadership. The group was eager to test advanced technology it had under development contract, and proceeded to visit Baltimore for a review and for meetings with city engineers. A delay in the Goddard heat pipe development program meant that its application in Baltimore would have to await another opportunity; however, the Goddard people had caught the spirit of the project, so they shifted their attention to how more conventional technology might be brought to bear. An engineering consulting firm, already under contract with Goddard, was asked to produce a thermal model of Baltimore's Pulaski incinerator as the basis for determining the feasibility of using steam generated by the incinerator heat. The study was nearly a year in process, providing data showing that several promising alternatives were uneconomical. There remained the possibility that electricity could

* The cases are not "representative" in a statistical sampling sense, they do demonstrate the breadth of topics undertaken.

be generated at the incinerator to meet 100 percent of plant needs while producing some surplus. This feasibility depends on working out an arrangement with the Baltimore Gas and Electric Company. Here, when timing precluded the application of high technology, Goddard participants merely shifted to more conventional methods to respond to the client's needs.

The "Data Collection Platform" task became a demonstration of NASA technology previously used in a worldwide data collection experiment on oceanography and atmospheric investigations linked via satellite communications. Here, Golden, prompted by a colleague at Goddard, suggested that Water Supply Division officials consider this instrument system as an interesting supplemental experiment to their exploratory use of Landsat imagery as one means for determining various conditions of their reservoirs and watersheds. Exploratory discussions further revealed that the data collection platforms could enhance considerably a large aeration demonstration for which the Division was seeking a grant from the Environmental Protection Agency. The instruments were loaned by NASA Wallops Station, with technical instruction provided by both Wallops and Goddard personnel. Although the instruments are not fully adaptable to the application, they can provide adequate data on at least four key water quality parameters of interest. The instruments are in place at the Lock Raven Reservoir and the initial data is being received, with calibration, adjustment, and data analysis. The technical demonstration, though only in its initial stages, has generated considerable

interest at both Goddard and in Baltimore for more development work in instrument technology to measure fresh water conditions, and in other applications of the platform, in conjunction with satellite communications, to Baltimore water quality monitoring and water supply operations. Economic feasibility has yet to be tested. Here is an excellent example of the synergism possible when technology sparks innovation through application, to generate another stimulus for technical advance and further application.

When Golden was asked to take up the task of improved insect (roach) control in Baltimore public housing, he quickly contacted several acquaintances in the Agriculture Research Service--ultimately finding an extension entymologist at the University of Maryland. The entymologist was put in touch with the appropriate officials in Baltimore, and as progress was reported over the next year, Golden declared the task completed in September 1975. In a sense this was true; through the BAP, resource (the entymologist) had been brought to bear on the problem. The BAP had performed a consultant or advisory role. However, the entymologist was busy training the control crew, demonstrating new techniques and new chemical agents. He discovered that a variety of factors appeared to be converging to produce, possibly, a roach immune to most known pesticides. He developed plans for conducting research along with continuing demonstration, but recently appeared blocked by a classic problem in organizational behavior--second level supervisors feel threatened by subordinates who learn "new" technology;

subordinates become frustrated at the resistance to change (which they perceive as correct)--both demonstration and potential research may be stopped. Here the relatively straight forward application of current technology had unexpected (though not unpredictable) organizational results. It also led to a technical discovery thereby stimulating further, probably important, research of potentially wide application.

In July 1976, the Baltimore Department of Health conducted a management workshop at which the agency leadership and a representative group of employees met to mutually explore what the goals of the Department ought to be, and how to organize to meet them. This was considerably removed from the progenitor activity--discussions between Golden and the City's Director of Telecommunications on how to demonstrate practical telecommunications applications that might be used in city departments. It was agreed, after discussion with the Commissioner of Health that such a demonstration, in that department, should be the subject of a workshop, bringing together user requirements and technical system descriptions with Goddard personnel acting as "facilitators." Further discussions revealed that "user requirements" could hardly be defined since many organizational questions remained open--including possible changes in the way the Department defined its mission. The workshop opened a new dialogue in the Health Department with a potential for organizational revitalization--with or without new applications of technology.

There is one area where Golden clearly has given technology a firm "nudge" instead of awaiting "user pull"--and that is in the area

of potential applications of solar energy. He was largely responsible for stimulating city interest in five separate tasks for solar energy use. Golden, with the assistance of Goddard engineers, arranged for consultants, specialists from industry, experts from Federal agencies, and others to provide briefings to various city officials at different times. The overall purpose was to acquaint officials with the potential, the state of the art, and practical considerations in the use of solar energy for space heating and cooling, and domestic hot water heating. Three serious efforts were made to obtain Federal grant funds for demonstration projects, one of which was successful, creating considerable interest and goodwill. Each of these efforts required bringing together city officials, architect/engineer consultants, and representatives from industry to join in the development and submission of a proposal. Here is an example of technological "consciousness-raising", helping city officials to become conversant with a new energy application and to learn the rudiments of how to get what they want and need as purchasers of new technology.

Participation in the BAP and Reaction

Participation in Baltimore reached deepest into the Departments of Public Works and of Housing and Community Development. Among the others it tended to be limited to the top two or three levels. Fully one-third of the tasks are being conducted in the Department of Public Works, where enthusiasm for the project is the highest. Senior officials

in the Police, Planning, Health, and Fire Departments appreciate the "consultant" role of Golden--all work well with him and view him as an asset. The Director of Public Works and a senior official of Housing and Community Development periodically engage Golden in "brainstorming" sessions, looking to future problems and opportunities. Few others had such extensive contact with Golden, and he has not made it a practice to initiate periodic exchanges with department heads in the absence of a request from them. This combined with the "low visibility" of the project, does not facilitate systematic consideration of technology in the problem-solving process among the less involved departments.

At Goddard, about 60 people have had involvement with the BAP. It varies from a single consultation to months of research or development. Whatever the involvement, it seems to generate unusual enthusiasm and a genuine desire to be useful to Baltimore officials. Little evidence has been found of "technological arrogance" which limits receptiveness to technology transfer.

Some institutional factors at Goddard appear to hinder the full impact of the project. For example, in the "fire station location" task, Goddard was to make a supplemental input, but the work lagged because of the BAP priority was insufficient to complete the task . . .

> The JHU [Johns Hopkins University] work is nearing completion. It presently appears that the GSFC program because of relative priorities cannot be completed in time to significantly influence the outcome of the JHU work. Because of his personal interest in the subject, Mr. [GSFC employee] will continue

> his work with the program on a lower priority basis. The task is otherwise dropped from the active list. 13/

A related problem is the reluctance of Goddard scientists and engineers to be involved in the BAP for any substantial amount of time to avoid being identified with a secondary rather than a primary aerospace NASA mission--thus becoming possible prime targets for the next reduction in force when agency employment is being cut. This is a concern which the panel believes to be legitimate, suggesting the desirability of more formal status for the project at GSFC. Although provision has been made for time to be charged against the BAP as a distinct financial management project number, considerable time expended by GSFC staff appears not to be reflected in the formal accounting system. Unfortunately, this prevents any reasonable estimate of the project's cost to Goddard. The BAP is publicized from time to time via local Goddard notices, but it is not perceived to have substantial top-level support as a priority Goddard activity. Thus Golden and Peake have had to take the burden of convincing colleagues that it is legitimate and valuable for them to assist with the appropriate BAP tasks. But the fact that the BAP is not perceived to have top-level support reduces the incentive of many Goddard employees to become involved in it.

13/ Interim Progress Report, March 1976, p. 4.

Chapter IV

Findings and Recommendations

> Clearly, champions for specific products there may be. But what are needed are 'champions'--or rather 'advocates'--of technology transfer as a process. These are individuals who are not product--but process-oriented. 1/

The Nature of the Evaluation

The task presented to the panel called for an " . . . objective evaluation of the achievements of the NASA/Baltimore Applications Project . . ." In recent years there has been an increasing tendency to identify the term "objective" solely with those assessment processes based upon numerical analysis. The panel rejects the notion that any assessment other than a numercial or statistical analysis is less than an objective evaluation. In this case, both the nature of the BAP "experiment" and the lack of data which would facilitate a numerical analysis precluded this methodology as a principal means upon which to base the panel's evaluation. What the panel has done is to systematize the written data and oral testimony, applying its judgment and experience in terms of the guidelines available. Therefore, the panel believes that "objectivity" is fulfilled by a third party assessment (that is the panel) systematically applying a judgmental rationale to the data available and arriving at consensus judgments.

In the assessment process, the first task was to determine the rationale which should be applied. The starting point necessarily was

1/ Lambright, W. Henry and Albert H. Teich (Principal Investigators), Federal Laboratories and Technology Transfer: Institutions, Linkages, and Processes, March 1974, RDI Report No. 18, prepared for the National Science Foundation, pp. A-12, A-13.

the set of objectives or goals which the BAP sought to meet. These objectives were stated in the Memorandum of Understanding between Goddard and Baltimore, but were not extensively developed and precisely specified. In addition, the panel perceived that some shift had occurred during the course of the BAP project, in those goals. Therefore, the panel's retrospective delineation of what constitutes the objectives/ goals of the Baltimore Applications Project probably is more explicit than the combination of general goals defined in the Memorandum of Understanding and those which existed in the heads of the principal participants at Goddard and Baltimore when the agreement was signed.

Another question involved in establishing the evaluative framework has been whose goals to use in judging--those of Goddard or Baltimore? It should be recalled that Goddard had goals both for itself and for Baltimore, but these did not necessarily fully represent Baltimore' goals for the BAP. The panel decided to review the project's achievements in terms of: (1) Goddard objectives, then (2) Baltimore objectives--making these as explicit as possible. In addition, the panel added a third category of objectives which never were explicit in the documentation, but which were implicit by the very existence of the project--that is, third party or the public's stake in the project.

Next, the panel sought to develop indicators which could be used to judge relative goal achievement. A tempting indicator was the number of "hits" or technology applications actually put in place.

This can be characterized as "product orientation" where the principal focus is on utilization rather than the transfer of technology. In its report on technology transfer and utilization, a committee of the National Academy of Engineering made this distinction between the two:

> Technology transfer--The process of collection, documentation and successful dissemination of scientific and technical information to a receiver through a number of mechanisms, both formal and informal, passive and active.
>
> Technology utilization--The process through which government research and technology is transformed into processes, products or services that can be applied to actual or potential public or private needs. It may also mean the secondary or horizontal application of a technology that has been developed for a particular mission, and, after modification and diversification, fills a different need in another environment. 2/

The selection of the "user-pull" strategy clearly put the emphasis on a transfer type of activity, subordinating "product" as a principal measure of goal achievement. The transfer concept places greater or even primary emphasis on the process by which technology is diffused. In fact, the emphasis upon the BAP as a "pilot" project and as a "experiment" in the Memorandum of Understanding focused attention on learning more about the process by which either transfer or utilization is achieved. Here, the focus was on "learning" both by Baltimore officials and by Goddard staff. The general role played by the project director (Tom Golden), as perceived by him and accepted by Baltimore officials, emphasized the transfer process rather than the utilization process.

2/ National Academy of Engineering, Technology Transfer and Utilization: Recommendations for Re-directing the Emphasis and Correcting the Imbalance, (Washington, D.C.: National Academy of Engineering), February, 1974, pp. 4-5.

> Among these roles are several that seems to stand out. Because of the technology pull emphasis the earliest role has been that of problem seeker and problem identifier. Once contact with the department was established, interviews were conducted which probed insofar as possible into the set of problems the interviewer felt to be important. Insight into where to go to get information on possible solutions was necessary so the next role became one of information gatherer or agent. . . . there are other roles that have been played. These fall into the advisory category . . . Others are akin to the role of ombudsman . . . The Director has been in the role of a grantsman. . . On many occasions the part of technology assessor has been required. Some of these events. . . have entailed recommendations against incorporation of certain technology. Other tasks have involved a role as an active 'doer' of a task. . . and sometimes as a 'doer watcher' . . . 3/

There was an unavoidable tendency for the panel to adopt a product orientation during the evaluation. This was resisted for two reasons: (1) the explicit indication among the participants that technology transfer was the purpose of the experiment, and (2) a recognition by the panel of the desirability of using multiple indicators in evaluating the success of the project. The main difficulty was finding substitute indicators for the more traditional technology applications approach when one is to judge the relative achievement of a process-oriented project. A nagging question was, What constitutes a transfer of an application? Is a "hit" registered:

(1) When a demonstration is effected?
(2) When data and advice are provided?
(3) When a test is undertaken or a technique or product is tried?

3/ Tom Golden, Baltimore Applications Project, Second Annual Progress Report, Greenbelt, Maryland: Goddard Space Flight Center, June 1976, pages 9-10.

(4) When activity results in a study or workshop? or
(5) When a particular application is put in "place"?

Golden's progress reports revealed that when a task resulted in any one of these, the task usually was closed out and considered completed, suggesting that Golden considered that a transfer and/or utilization had been made. The panel was unwilling to fully accept Golden's "close out" of a task as indication of a transfer or an application. Rather, they opted to make their own judgment on the basis of what was learned and achieved.

There were two key barriers to the panel's making a final judgment with respect to the accomplishments of the project: (1) incomplete data--there was insufficient information on each BAP task to fully understand whether the task had been completed, dropped, delayed, or otherwise developed; and (2) the time between the initiation of the BAP and the start of the evaluation (approximately 27 months) was too short to observe a significant number of the full-life cycles of the tasks. On this latter point, it is important to keep in mind that the user-pull strategy may be a longer process than the "technology-push" strategy. The BAP strategy adopted by Goddard required addressing a wide variety of problems identified by Baltimore officials. The problems then were screened in terms of potential technological applications. Next a search had to be made for applicable technology, followed by a further series of screening and information gathering. Some problems inevitably had no overt technological solution; others might be subject to solution, with further development efforts; and still others might be ripe for traditional technology application.

It is for these reasons that the panel undertook the assessment of the BAP in terms of achievements and their relationships to the objectives of the project, emphasizing the qualitative aspects of process changes ("transfer"), with secondary attention to applications or utilizations completed.

An Assessment in Terms of BAP Achievements

Any assessment of achievements under the Baltimore Applications Project must take into account the environment in which most city governments operate. Both the decision-making and the substantive context of urban local government may present highly resistant barriers to technology transfer or technology utilization.

Local government decisions and activities, such as those of Baltimore, are best typified as short term and immediacy-oriented. In other words, today's problems demand and receive first priority. Long term perspectives, strategies, planning, and active search for innovations receive lowest priority. Whether or not this is representative, desirable, or necessary, are not the topics for this report. What is relevant is the effect of this type of management on the introduction and use of technology. Some identified consequences of local management, as practiced in Baltimore, appear to be:

- Difficulty in allocating significant staff resources to "thinking through" how to utilize technology (if at all) in resolving current problems.

° The difficulty of justifying to the public, and explaining to the press, the allocation of resources to understanding technology sufficiently to utilize it well in resolving current problems.

° A need for short term fixes on visible city problems.

° Problems in obtaining wide technical and managerial consensus on how to resolve a problem in time to satisfy public demands for solution.

These characteristics of local government activities have, of necessity, shaped NASA's activities in testing technically-based feasible solutions to Baltimore's known problems. They also directly affect the way in which criteria can be applied to evaluating the success of the NASA's Baltimore Applications Project.

The Goals/Objectives of the BAP

Before going into a detailed assessment of the BAP achievements, it is useful to list briefly the BAP objectives from the perspectives of Goddard, Baltimore, and the "third party" or general public, along with the panel's rationale for using this particular set of objectives.

First, from the Goddard perspective, there were four main rationales for the BAP, namely: (1) as a response to a "constituency" request, (2) as an experiment with "user-pull" technology transfer, (3) as an opportunity to increase the use of research and development

benefits accomplished under Federal sponsorship, and (4) as a means to enhance Goddard's and thus NASA's image.

The Baltimore Applications Project came into existence primarily because of the request on the part of a Baltimore official, Robert Embry, to NASA Administrator Fletcher for the use of a NASA technical consultant similar to the one supplied to New York City. The inital request was reinforced by interest on the part of a Member of Congress in Baltimore, Paul Sarbanes, (elected to the U.S. Senate, November 1976). It is important to recognize the BAP as a legitimate and natural agency response, creating both an opportunity and a rationale for the BAP in the first instance. The extent to which the "constituency" has been satisfied by the Goddard response is an important element in judging the project's achievements. Given the nature of the leadership at Goddard when the request was made (1973) and the nature of the request (seeking technical advice and assistance through use of NASA consultant), the decision to select a "user-pull" method for technology transfer was quite reasonable.

Donald Hearth, who, as Deputy Director at Goddard, provided the policy direction for the project, was convinced that the general "technology push" nature of most of NASA's technology transfer/ technology utilization programs lacked an element of reality. The request to assist Baltimore provided an opportunity to experiment with a strategy in which client officials identified their problems and determined priorities. In one sense, this approach was considerably more passive than the technology utilization programs of NASA.

The increased use of R&D products is a fundamental objective of any application, utilization, or transfer effort irrespective of the method used. Finally, although it is not explicitly acknowledged in the agreements or reports, an important reason why NASA has undertaken such projects has been to improve its standing within both its national and local "constituencies", and provides intangible support for NASA's programs at the policy level.

Second, from Baltimore's perspective, the City had as its primary purpose in requesting the project, improving its ability to apply technology in addressing some of its problems. Within this general purpose there existed three subgoals: (1) to become more systematic in the approach to problems and the use of technology within Baltimore, (2) to use technology as another means to improve the City's image, and (3) the hope that, with greater technological sophistication, the city might improve its access to Federal grants. In essence, with the NASA project, the City was being given access to considerable breadth of technological competence and a personal means to tap it for use in whatever fashion the City could make of it.

Finally, there are the third party or general public goals, although these were never made explicit, and, in fact, were minimized because of the bilateral nature of the Baltimore Applications Project. None of its fundamental purposes were directed at third party (larger public) benefits except for the kind of understanding and lessons that might be forthcoming by NASA's trying a mode of technology transfer

significantly different from its typical style. The first and most important goal, hopefully, to be realized was to determine the potential for wider application of the Baltimore Applications Project "user-pull" style. A second goal, important to the general public, is the extent to which the BAP can satisfy the four criteria for technology transfer postulated by the National Academy of Engineering Committee: (1) evidence of widespread public benefits, (2) significant economic benefits (or cost avoidance), (3) little evidence of adverse effects, and (4) reasonable agreement among the prime participants on objectives, benefits, roles, responsibilities, and milestones.[4/]

Goddard Objectives

The first objective of meeting a constitutency request was generously fulfilled through the Baltimore Applications Project. The Memorandum of Agreement between Goddard and Baltimore put NASA in the posture of being fully responsive to a reasonable initiative on the part of Baltimore officials. The overwhelming consensus on the part of Baltimore officials is that Tom Golden, and through him the Goddard Space Flight Center, have given all the cooperation that could be desired in meeting the technological needs identified by Baltimore officials. Neither the manpower supplied nor the resources available from Goddard has been strained by Baltimore requests, so the full extent of Goddard's

4/ National Academy of Engineering, Op. Cit. pages 18-19. It is questionable whether or not these criteria are directly applicable to the BAP which was a process oriented, minimum cost activity to Goddard Space Flight Center because the NAE criteria were meant to be applied to " . . . projects of technology transfer and utilization, prior to the commitment of major funding for any implementation activities . . ."

responsiveness has yet to be tested. On the other hand, those officials who have interacted most frequently with Golden have been both realistic and considerate, exercising some restraint in "tapping" the system. It should be recalled that the origin of the BAP was an overt request from a senior Baltimore official, so the project was not a "put up job" on the part of NASA. It is the panel's belief that the "user-pull" strategy probably is most successful in response to a request such as was the case with Baltimore. The single, restrictive condition operating here was the fact that the BAP operated within the immediate geographic area of Goddard and no attempt was made to extend its geographic impact. This criticism is of marginal relevance in that most Federal agencies, like industrial organizations, seek to be good neighbors in whatever community they are located by encouraging public service activities related to the needs of the immediate community. A counter-argument could be the inappropriateness for an organization like Goddard to provide such assistance outside its immediate geographic area.

There are a half dozen indicators of achievement relevant to the goal of demonstrating a user-pull strategy. One of the foremost is that this style of technology transfer identified areas of application that otherwise would not have been uncovered. For example: the grass/tree planting task, the insecticide technology task, the silt utilization technique task, the gasoline/water emulsion task, the BOD/heavy metal detector task, and the algae-nutrient detection task. Second, the fundamentally passive strategy intentionally adopted by Goddard provided

a substantial degree of flexibility in dealing with problems, and permitted seeking solutions wherever they might be found (not limited to NASA laboratories). This provided considerably greater opportunity for seeking appropriate technological solutions. Third, the generally passive nature of the user-pull method, combined with a strategy for "low visibility", helped Golden gain acceptance and cooperation among Baltimore officials, stimulating an open, candid relationship, providing the widest possible avenues in the process of problem-search. Fourth, this strategy, in combination with Golden's personable, unassuming approach, overcame the stereotype of Federal arrogance which sometimes accompanies relationships between Federal and local officials. Fifth, this strategy also avoided false expectations on the part of Baltimore officials about quick, easy, or glamorous solutions to their problems. This helped maintain and solidify an honest, healthy dialogue about City problems and potential solutions. Sixth, operating within this low visibility, user-pull strategy, tended to avoid mistakes, or at least to minimize the repercussions of a mistake. Since Golden stopped short of actually implementing the application of any technology, he avoided interjecting himself into agency operating problems which frequently are in the thick of "politics". The panel observed that Golden performed a classic "gatekeeper" function as the link between the world of technology and the operational world with its specific problems. He was or became: (1) widely acquainted in the host organization and recognized as having extensive external contacts; (2) recognized externally as a mode of information flow into

and out of the host organization (principally with respect to Goddard involvement); and (3) acknowledged to be unusually curious and innovative.

There were several shortcomings, costs or trade-offs involved in following the "user-pull" experiment. One, for example, was that the low visibility and general informality with which the project was conducted may have reduced wider participation at Goddard, reducing, as well, the perceived priority given the project at Goddard. This may have caused some opportunities to be missed. As one panel member put it, the lack of BAP formality could have "made other NASA personnel less aware of it, less cognizant that it was a highly ranked value of the organization (i.e. GSFC), and, hence, indifferent to it or even reluctant to cooperate."

Second, although the BAP has been described as an "experiment" there was no systematic attempt to preserve data, provide adequate monitoring and recording of the experience, and provide consistent follow through.

Third, there were a few instances in which technical assistance or advice was withheld consciously because it was perceived that such advice or technological products were commercially available, and, therefore, should not be provided through the BAP. Whether the possible problems presumed to be avoided by withholding such assistance outweighed the possible advantages of providing such assistance cannot be assessed; hoever, there were some inconsistencies in the application of this practice (such as the considerable emphasis on solar energy applications and the operation of the Health Department Workshop).

Finally, Golden concentrated his efforts in the first two years on those City departments considered to be most interested and likely to have problems which lent themselves to technological resolution. This had the positive effect of quickly uncovering those problems most amenable to technology; it also pushed into a secondary position problems of high priority to the City that, possibly, were less susceptible to technological intervention.

Generally, those indicators demonstrating the increased use of research and development benefits were positive, although a combination of the nature of the process, the short time involved, and the lack of complete data on the tasks prevents a full answer to the question, How much technology transfer occurred? First, it should be recognized that the BAP extended the use or benefits of research and development--especially as a search "activity"--at only marginal cost to NASA (probably less than 1 1/2 man years of effort per year).

Second, in more than half of the nearly 70 tasks undertaken, R&D competence, developed in the space program, were applied in some fashion to problems of the City of Baltimore. Again, it was not possible to measure the results in a quantitative fashion; indeed, in a good many cases it will be some time in the future before results are fully identified. Yet, results are apparent in the general raising of the technological awareness of senior officials throughout the City and their acknowledgement that such has occurred.

Third, on at least 15 different tasks the City of Baltimore was used or proposed to be used as a laboratory for NASA applications.

In some instances, the preliminary assessment, just prior to application, indicated that the potential application would be inappropriate and therefore a waste of time. In others, the potential exists for actual application but remains dependent upon results elsewhere (such as completed development activities, commercial certification, etc.). In a number of instances the demonstration has occured, is in the process of occurring, or is planned to take place in the near future. Examples of the first category are the lead paint detection, the police location system, and satellite communication link projects. Examples of tasks temporarily in a holding pattern are flat wiring, the application of NASA program management, incinerator energy conversion, Modular Integrated Utility System (MIUS), and heavy metals detector. In the category of ongoing or soon to occur applications are Landsat data utilization, solarization experiments, zinc paint tests, and the data collection platform.

The one negative indicator on the objective of increased use of research and development benefits is the lack of clear "applications" in terms of traditional technology utilization. However, it should be observed that the BAP model of technology transfer is not principally directed toward "products". The execution of this project--as understood by Golden--was to stop short of implementation.

As conducted, the experiment requires a more systematic follow through in the development of information to fully track tasks to their conclusion. There is some reason to believe that tasks which have been discontinued and appear not to have had a "product" require additional follow through, particularly where the action agent is outside of NASA.

Two of the three indicators related to the objective of an improved NASA image can be considered positive. First, the consistently positive reaction from Baltimore City officials to the project and to Golden put NASA in a very favorable light among those who were closest to the project. The some half dozen news articles which have appeared in Baltimore newspapers contained no criticism whatever of the project, were most favorable, and tended to be optimistic in terms of benefits accruing to the City and their importance. Second, the low profile, passive nature, typical of the NASA strategy has avoided any backlash of the "hard sell" attributed to other kinds of technology transfer. However, the same low profile strategy has tended to limit awareness of the project both at Goddard and in Baltimore. Hence, except for those who have been working directly on a BAP task within the City (and some reporters) few have any understanding of the project and many are ignorant of it.

Baltimore's Objectives

Baltimore's principal purpose from the outset was to obtain NASA help in order that the City could better address its problems through a more effective use of technology. Virtually all indicators show positive results toward achieving this objective. First, the City did become more systematic in the application of technology. The BAP presented the opportunity and a congenial vehicle by which to effect this. It is true that the "technologically most intensive" departments have done the most--the Department of Public Works (with the highest concentration of engineers) being foremost among them. Baltimore officials verify that the BAP has

made them (principally at the cabinet and subcabinet levels) more technologically conscious. In addition, there has been a raising of the "time horizon" of this level of officials--i.e. they exhibit a greater awareness and concern about problems involving long-term effects and solutions.

Second, judging by press reports of BAP activities, one would have to conclude that it has had a positive affect on the City's image as a progressive city. To some extent, the "low profile" strategy has limited this, but the project is now approaching a stage where wider dissemination of information about its activities should provide the basis for judging outside reaction. However, the reluctance of Baltimore officials, informally, to pledge financial support to fully underwrite the BAP suggests a relatively low priority for the project.

Third, Baltimore did use its improved technological awareness and the capability of BAP to enhance its access to Federal grant programs. Largely through Golden's searches and initiatives, the City was successful in obtaining a grant to finance a solar heating demonstration project--one of several such activities undertaken or planned.

Fourth, an unanticipated benefit to the City has appeared--"technological reassurance." On a number of occasions, when an agency is confronted with several alternatives, BAP has undertaken a brief technology assessment which resulted in confirming the choice or inclination of City officials. Much of this kind of activity takes place in the BAP screening process before a formal task is identified, so it has remained

largely unrecorded in Golden's reports. This "reassurance" can be equally as important as assisting in the application of a different or "new" technology.

Finally, there is the synergism associated with problem identification, and the search for possible solutions. One application attempt leads to new perspectives (perhaps new knowledge) and on to another unanticipated application. The insecticide technology task is a case in point. Initially, the idea was to search out chemical agents which had not yet been used in Baltimore. Dr. Woods, in attacking the problem, brought to bear not only new chemical agents but improved methods of application, effective training of the control crews, preventive techniques, and a concern for social and other effects. In time he uncovered the more general problem of roach immunity to chemicals, and the opportunity to undertake some groundbreaking research which could provide the basis for more effective roach control generally.

When one reviews the tasks pursued under the BAP, the question arises as to whether or not the City's first priority problems are being dealt with. The panel received the impression that Baltimore officials doubt the applicability of high technology to many of the really pressing problems of cities--e.g. improved housing, or fiscal stability--so that programs like the BAP are used principally to tackle lesser problems. Certainly no dramatic solutions can be claimed by the BAP. However, two assertions must be borne in mind: (1) the suggestion that high technology is of little use in addressing the major problems of cities

has yet to be tested, and in any case, probably is unrelated to the process of technology transfer being addressed here; and (2) major urban problems are not monolithic, but are composed of many parts so that the improvement of any portion can contribute to the solution of the larger problem.

Third Party of Public Benefits

Before discussing the presence or lack of third party benefits, it is important to note that the BAP is bilateral and not directed toward third party benefits. This is in contrast to most other technology transfer or utilization programs, e.g. NASA Technology Applications Teams, its Technology Utilization program, or Public Technology Incorporated's consortium.

Most of the positive evidence of third party benefits is of a prospective nature. It has provided a new experience with a different mode of technology transfer, which might be applied in other places. The system can be improved as will be discussed later, but even in its experimental stage BAP demonstrated a capability for raising the technological awareness of top City officials.

There is little evidence of "application" in the traditional sense of new technology implemented in Baltimore, or more importantly, that BAP influenced other groups to apply technology. Thus far the BAP has not developed ties with industry that would encourage or facilitate commercialization of BAP applications, or lead to longer

term relatior hips of technical assistance once the experiment is concluded. It may be too early to assert flatly that a bilateral program of technology transfer, based upon user-pull, does not provide any substantial third party benefits. Such benefits are most likely to be derived from the tendency of peer cities to copy successful experiments/applications observed in sister cities. The BAP is too young and at too low a level of visibility for such affects to be evident yet.

The Question of Cost-Effectiveness

From the beginning the panel recognized that traditional cost-effectiveness measures probably would not be applicable. The lack of data has confirmed this. In Baltimore the principal "resource" applied has been the time of City officials, and this could be estimated only in broad terms by department or agency heads; such data collection was not undertaken since it was judged that the data produced would not be worth the effort to collect it. Much the same situation exists at Goddard. The BAP is a recognized project and those who contribute work have been encouraged to charge time to it; but no one outside the project office has done so. Interviews with participating GSFC officials suggest that time ranging from a few days to several weeks has been applied to different BAP tasks. The BAP project office costs consist principally of between one and two man years represented by Tom Golden, the project director, and others in the Office of National Needs spending part time on the project.

The panel considers these costs to be negligible--both for Baltimore and for Goddard--when one considers the amount of overhead time commonly expended in either organization. The benefits have been substantial, but rarely measurable in terms of days gained or dollars saved by the introduction of a technique or device. However, some such benefits are occurring. For example, the use of zinc-based paint on heavy equipment has the potential of reducing maintenance (and replacement) costs, but is still in the process of testing and evaluation. More typically, BAP tasks had a longer term to completion, and many result in systems improvements which are difficult to measure. Examples are the data collection platform, now in the early demonstration stage, where the goal is improved water quality monitoring; or the application of NASA program management techniques which is directed at adapting management tools for use in several Baltimore departments. Here benefits are less discrete.

One of the major needs of urban government officials, as evident from the Baltimore experiment, is to be kept aware more broadly of technology that might be of use to them in their activities. Golden served this need well, and it should be recognized as an important short-term success even though its benefits are not easily quantifiable and may be indirect or delayed. Part of this information process has been the raising of technical awareness among key officials so that this dimension of problem identification and solution is more systematically used.

The panel believes that the cost-benefit ratio for the BAP is on the side of benefits derived compared to cost in view of the many systems benefits (as well as those still in process) and the relatively small investment by either GSFC or Baltimore.

Recommendations

It is important to keep in mind the framework within which the panel makes its recommendations. First, the panel was asked to evaluate the BAP in terms of the project's purposes, and how it was conducted. Second, the panel has not collected data on other NASA technology transfer or utilization programs, or programs elsewhere, for purposes of comparison. Third, the panel has viewed the BAP, based on its stated purposes, as an experiment in technology transfer, and not in terms of an indefinite, continuing responsibility of the Goddard Space Flight Center. The study is relevant to the more general question of the extent of NASA's, or of the Federal Government's, role in technical assistance to local government (and others as well); but, the panel believes this to be outside the scope of its task and does not address that question in this study.

1. The Baltimore Applications Project should be continued for at least two more years to: (a) obtain better, more systematic data for assessing impact--both in Baltimore and at Goddard; and, (b) to test what the panel believes are desirable shifts in the strategy of the project.

With respect to the first point, (a), the BAP is a process-oriented exploratory project, which, necessarily, had to be flexible in

approach and conduct. In retrospect, it is evident that considerably more attention should have been devoted to systematic data collection and the accurate tracking of tasks. In order to learn the most from such an experiment it is necessary to record as much as possible (not to be confused with extensive formal reporting systems). Golden kept a journal on the project, beginning in April, 1974, but the entries began to grow shorter in the fall of 1974 and ceased entirely in the spring of 1976. In the future a daily log book or journal, supplemented by file references, and running accounts of task histories or life cycles, is an absolute minimum. Task coordinators, from the beginning, should be asked to keep some estimate of time associated with the task, both on the Baltimore and on the Goddard sides.

To some extent, the data needed to make a full judgment is not yet available because the full skein of events associated with many of the tasks has yet to unfold; therefore, evaluation is, of necessity, preliminary and provisional. Two examples from the mini-cases are the incinerator conversion task and the insecticide technology task. The former will be several years more in the process of construction and test, with the application of more advanced heat pipe technology still an option beyond that. The roach control task is likely to either be phased out or blossom into a second stage of more intense activity including the initiation of some fundamental research.

Addressing the second point, (b), regarding desired shifts in the project, the panel believes that five modifications can be made in

the BAP which will provide valuable experience to more fully evaluate the feasibility and usefulness of the user-pull strategy. The changes which should be instituted are:

- drop the "low profile" stance, making a determined effort to raise the level of awareness about the project in Baltimore and at GSFC,

- be less "conservative" in withholding assistance from Baltimore officials when commercial sources are perceived to be available;

- make a greater effort to identify NASA technology fully exploiting Technology Utilization resources, which might be applied to Baltimore problems;

- give serious consideration to taking a task or two into the implementation stage where political sensitivities may be found; and

- consider the desirability of having Baltimore share at least some of the cost, now fully borne by GSFC, of the project director.

The panel believes that the usefulness of the low visibility approach, which was needed initially, has been outlived. There is too much evidence of the need for greater awareness of the project in Baltimore and at GSFC. The panel does not endorse adopting a "hard sell" approach, but a judicious publicizing of the project, its purposes and tasks. This will help in sharing the learning being accomplished and encourage wider involvement. It should also stimulate better follow-through in keeping all involved fully informed, and possibly, clearer priority for the project in Baltimore and at Goddard. The panel

found limited evidence that participation by some at Goddard was discouraged by their supervisors on the basis that the BAP lacked a significant priority.

Golden has been very cautious in avoiding tasks which would place the BAP in the position of providing services that are available on a commercial basis. The panel does not quarrel with this general policy, but questions the rigidity of interpretation. To the extent possible, advice and assistance should be provided agency officials, carefully tracking progress on such tasks. This hesitance has been most notable in the one field where NASA probably has the most to offer in the way of technical competence--communications.

After two years much of the problem identification process has been completed in the more technologically intensive agencies. The priority always has been on defining problems from the perspective of Baltimore officials, yet the project director now has considerable familiarity with the City, its officials and problems. More attention should be focused on specifically what NASA technology might be most useful to Baltimore problems, a process that has not been neglected, but one which has been considerably submerged to problem identification. Full use should be made of NASA's own Technology Utilization resources. This will help provide more timely information as well as assist in illuminating the question of how applicable high technology is to urban problem-solving.

Those tasks which appear to impinge on political sensitivities or carry the possibility of some involvement in implementation have been

carefully avoided. Some of these may be problems of high priority. "Playing it safe" precludes the opportunity to test technology application, and may tend, over time, to limit applications to problems of secondary importance. If the purpose of the BAP is to learn, some risks must be taken.

Finally, some consideration should now be given to cost-sharing the technology agent's salary on the part of Baltimore. Baltimore officials profess a belief that the BAP has proved useful. If it does have real value to Baltimore, some such cost-sharing is in order to more fully demonstrate this judgment. One of the panel members believes that, as the basis for continuing, Baltimore should bear half of the agent's salary. By sharing these costs, Baltimore officials may be stimulated to make more effective use of this resource. Although there appears to be no serious opposition among Baltimore officials toward some cost-sharing, they strongly believe that fiscal and other problems peculiar to the central city require special assistance from Federal departments--and technical assistance such as the BAP is one such mode of welcomed assistance.

2. As a second priority, GSFC should consider a limited extension of the BAP experiment to another location, under certain conditions, in order to more fully determine its general applicability as a practical means for accomplishing technology transfer. Such an extension should be at a location geographically adjacent to Goddard, should be on the basis of initiative from the client (not limited to city government), and should incorporate specific goals, systematic data collection, and evaluation.

The panel believes that the project could be tested usefully in another location to more completely determine whether its relative success is the result of the strategy or of factors peculiar to Baltimore. The receptivity of Baltimore officials to the BAP was impressive, raising the possibility that other locations might not be as congenial. The panel is convinced that any second location should be adjacent to Goddard--e.g. within an hour's drive--for several reasons: first, to minimize cost to both parties; second, to provide the widest possible access; and third, to be consistent with the general Federal policy of faciliating good community relations between Federal installations and the communities in which they are located and from which they draw their employees.

In considering a second location, GSFC officials should include county and state governments, as well as municipal, but should undertake a second iteration only upon invitation. The panel believes that this is important to the success of the user-pull strategy for technology transfer and greatly facilitates the initial establishment of the program. As in the case of continuation of the BAP, one panel member believes that the earnest involvement by the host government can be demonstrated by equally sharing the cost of the agent's salary.

Finally, any test of the BAP concept at a second location should, to achieve maximum value and understanding: (1) provide clearly stated, specific goals for the experiment; (2) establish a means for systematic tracking of tasks and full data collection coordinate with the

development of the basic memorandum of understanding; and (3) include a process for evaluation involving both GSFC and client personnel. Such a project should be organized and instrumented as a true experiment in order to be able to distinguish the differences between BAP_1 and BAP_2.

In conclusion, the panel wishes to commend the Goddard Space Flight Center for sponsoring a successful demonstration of the "user-pull" strategy for technology transfer. It definitely is a contribution to a better understanding of the process of technology transfer and utilization. The technique requires a willing and cooperative client (Baltimore), a patient and sharing sponsor (GSFC) and a politically sensitive, technically competent and personable project director (Tom Golden). All of these are absolutely vital to achieving results through this strategy for technology transfer.

APPENDIX A

Biographical Sketches of Panel Members and Staff

Appendix A

Sketches of Panel Members and Staff

Charles F. Bonser

Dean of the School of Public and Environmental Affairs at Indiana University. The School has been responsible for the operation of one of NASA's Regional Dissemination Centers. Dean Bonser has served as Associate Dean for Administration at Indiana University's School of Business, as Director of the Indiana State Tax and Financial Policy Commission, as Tax Advisor to the Indiana General Assembly and as Economic Development Advisor to the Lt. Governor of Indiana. Dean Bonser currently is President of the National Association of Schools of Public Affairs and Administration.

James D. Carroll.

Professor of Public Affairs and Director of the Public Administration Department, The Maxwell School, Syracuse University. He is a researcher on the Urban Technology Project being conducted by the Maxwell School and Syracuse Research Corporation with the support of the National Science Foundation. He was a staff member of the Office of Urban Technology and Research, the U.S. Department of Housing and Urban Development, in the 1960s. He has written several articles on science and technology policy.

Ruth M. Davis

Director of the Center for Computer Sciences and Technology, National Bureau of Standards. She has served as Director of the Lister Hill National Center for Biomedical Communications, Associate Director of the National Library of Medicine, and as Staff Assistant for Intelligence and Reconnaissance in the Office of the Director of Defense Research and Engineering, Department of Defense. She is the recipient of the National Civil Service League Award (1976), Rockefellow Public Service Award for Professional Accomplishment and Leadership (1973), the Department of Commerce Gold Medal Award (1972), and Federal Women of the Year Award (1972). She is a member of the National Academy of Engineering, the New York Academy of Science and numerous professional societies.

Francie E. Rourke

Professor of Political Science at Johns Hopkins University since 1961 and Chairman of the Department between 1964 and 1970. He has also taught at Yale University and the University of California, Berkeley. He was Director of the Commission for the Expansion of Public and Higher Education in Maryland, Vice-Chairman of the Governor's Commission for the Modernization of State Government in Maryland, and Treasurer of the American Political Science Association. He has been a member of the editorial board of the Journal of Politics and the Public Administration Review, and is now on the editorial board of Administration and Society. Among the books he has authored are Secrecy and Publicity Dilemmas of Democracy; Bureaucracy, Politics and Public Policy; and Bureaucracy and Foreign Policy.

Deil S. Wright

Professor of Political Science and Research Professor in the Institute for Research in Social Science, University of North Carolina. Since 1973 he has served as Director of the Master of Public Administration Program in the Department of Political Science. Professor Wright has authored or coauthored books, monographs, research reports, and articles in the fields of federalism, state and local government, public administration, intergovernmental relations, and public finance.

Academy Staff

Richard L. Chapman

Senior Research Associate of the Academy, previously served in administrative positions in the Office of the Secretary of Defense, U.S. Bureau of the Budget, and the Public Health Service; also as Staff Director for a member of Congress, Chief Consultant to House Government Operations Subcommittee on Research and Technical Programs, and Assistant Director of Research of the South Dakota Legislative Research Council.

Eleanor C. Hodges

Presently a candidate for Master of Arts degree in International Relations at the School of Advanced International Studies, Johns Hopkins University. Holds a B.A. in political science from the University of Delaware.

APPENDIX B

Memorandum of Understanding

NASA-Baltimore Applications Project

April 26, 1974

MEMORANDUM OF UNDERSTANDING
NASA-Baltimore Applications Project

Background and Objective

It is the policy of the National Aeronautics and Space Administration to encourage cooperative projects as a means of facilitating and accelerating the transfer of aerospace technology to public sector areas of concern.

In cooperation with the City of Baltimore, NASA agrees to undertake a unique pilot project of an initial two-year duration to test the feasibility and measure the effects of utilizing technology in the solutions of problems that affect the urban environment, generally, and that challenge the public administrators of Baltimore, specifically.

This experimental project is to be known as the NASA-Baltimore Applications Project, and will be conducted under the joint direction and coordination of individuals designated by the Office of the Mayor; Office of the Director, Goddard Space Flight Center; and the NASA Technology Utilization Office.

Project Administration

NASA will recommend a candidate for the position of liaison between NASA and Baltimore. The person recommended for this position will be known as the Director, Technology Transfer Project (Director, TTP). The individual recommended will be expected to possess current knowledge of NASA and the federal establishment, general technical skills, active imagination, and natural ability to work cooperatively with Baltimore City officials and citizens in pursuit of project goals. Selection of the initial Director, TTP, and any subsequent directors will be jointly determined by NASA and the Office of the Mayor.

The overall function of the Director, TTP, will be under the general administrative supervision and direction of the Director, Goddard Space Flight Center, or his designee. The daily activities of the Director, TTP, will be under the direction and immediate supervision of a designated official representing the Office of the Mayor.

The Director, TTP, will be housed in the Offices of the Mayor during the period of performance under this agreement, and the City will provide parking, office accommodations, and the necessary clerical and related support services, such as office supplies and telephone. GSFC will provide office accommodations and related support services at Goddard during periods when the Director, TTP, visits the Center in the performance of his work.

Memorandum of Understanding
NASA-Baltimore Applications Project

Expenses and Travel

GSFC will pay the full salary and benefits of the Director, TTP. Travel expenses will be shared among the participants on the following basis:

1. GSFC will pay all per diem and direct transportation costs, including local transportation, for all travel.

2. Problem-solving trips to research centers, industrial plants, technology libraries, etc., are considered project-related travel and the City of Baltimore will reimburse GSFC for such direct transportation costs (including local transportation) and related expenses (taxi, parking, baggage, etc.). Prior city approval of such travel is required for expenses to be considered reimburseable. Per diem costs will not be reimbursed to NASA.

3. Career-development travel expenses (e.g., for training or symposium attendance) are not to be considered project-related and are not reimburseable.

4. The Director, TTP, will bear the costs of commuting to and from work, whether at Goddard or Baltimore.

Outline of Project and Operating Plan

In cooperation with Baltimore City officials and under the immediate direction of the individuals designated responsible for his activities, the Director, TTP, will review and analyze those areas of particular concern to Baltimore officials. Problem areas identified will then be screened from the standpoint of their susceptibility to solution by the application of existing NASA technology or that developed by other federal research and development activities.

Certain on-going NASA-sponsored applications engineering projects may be of interest in this experimental project. The Director, TTP, will apprise city officials of these on-going projects, especially those that would seem to satisfy specified needs. The City of Baltimore agrees to provide appropriate sites, facilities, resources, and personnel required to test applications engineering projects it might select to address its specified needs.

In the search for available technology to meet perceived needs, all sources of technical information available to NASA and NASA contractors are to be made available to the Director, TTP. Among such sources and services are:

1. NASA data base including domestic and foreign aerospace technical reports and the published literature contained therein.

2. Professional expertise at NASA laboratories.

Memorandum of Understanding
NASA-Baltimore Applications Project

3. Current projects and accumulated experience of:

   a. NASA Technology Applications Teams

   b. NASA Biomedical Applications Teams

   c. Applications Technology Office, NASA Office of Aeronautics and Space Technology.

4. Technical information retrieval services. As required, these will be furnished by the NASA Scientific and Technical Information Facility, College Park, Maryland. The City agrees to purchase, at standard nominal fees, other tailored technical information retrieval services, provided by NASA-sponsored Regional Dissemination Centers, needed on specific problems. Such services will be authorized and approved by appropriate authorities of the City.

The function of matching existing technology to identified needs requires careful definition and screening, and a broad understanding of NASA R&D Programs and administrative procedures for conducting research and evaluation. NASA officials will work closely with the Director, TTP, in this regard, offering the guidance and counsel necessary for effective matching of technology to need.

Reports

1. Informal Quarterly Report. The Director, TTP, will furnish an informal activities report to NASA and Baltimore at the end of each quarter, to be completed the first week of the succeeding quarter. This progress/status report will document activities for the period and outline work plans for the following period.

2. Formal Annual Report. The Director, TTP, with the cooperation and assistance of the appropriate officials of Baltimore, will prepare and submit to NASA a draft of an Annual Report within thirty days following the anniversary date of this project. This report will document results, including major activities undertaken during the course of the experimental project. It is to highlight lessons learned, with recommendations for structuring any future and continuing efforts of a similar nature.

(Signature) 4/26/74	(Signature) 4/26/74
John F. Clark Date	William D. Schaefer
Director	Mayor
Goddard Space Flight Center	City of Baltimore

APPENDIX C

Summary of Tasks, Baltimore Applications Project

May 1974 - September 1976

This summary was derived from quarterly and annual reports made by the BAP Project Director, Tom Golden. It illustrates the variety and scope of problems with which he dealt, but does not include many informal inquiries made to him, and answered or otherwise disposed of, during this period.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Air Breathing Apparatus 1	Fire Department	Golden; PTI, Informatics, Inc.	Demonstrated. Decision not to purchase: (1) still have to get through window; (2) 50% increase (15 min.) in supply, (3) cost of equipping department and high pressure charging tank.
All-weather Road Patching 2	Public Works	Golden	Already use sylvax (commercially available) and are satisfied.
Fire Escape Device 3	Fire Department	Golden; Headquarters T.U., MSFC	Not available for demonstration; no commercial manufacturer of the device.
Flat Wiring 4	Department of Housing and Community Development	Golden, NASA, T.U., MSFC	Samples to HCD, U.L. tests had not been completed; no further follow through--departments to be notified upon completion of testing.
Glass Substitutes 5	Department of Recreation and Parks	Golden, GSFC Materials, Engineering Branch	Samples of Lexan with new type of coatings provided: improved resistance to scratching, but not sufficient to apply.
Grass/Tree Planting 6	Department of Housing and Community Development	Golden; ARS	Information and names of local contractors provided project manager of Coldspring. No further follow-up.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
High Temperature Paint 7	Public Works	Golden; Dr. John Schutt, Earth Resources Branch	Information on high temperature paint for pyrolysis plant provided; paint applied.
Computer Accounting for Housing Authority 8	Department of Housing and Community Development	Golden	Determined task could be accomplished by commercial organizations. No further action.
Probeye Demonstration 9	Fire Department	Golden	Demonstration made, department plans to buy several.
Sewer Flow Meter (Part of Water Quality) 10	Public Works	Golden; Headquarters, T.U.	Evaluation underway in Dallas, Texas, data to be given Baltimore upon completion of Dallas testing.
Soft Surface Materials Test 11	Department of Recreation and Parks	Golden; Headquarters, T.U. -SRI	Materials made available to department for test, no further follow-up.
Water Immersed Bearings 12	Department of Recreation and Parks	GSFC Materials Groups	Brainstorming session at GSFC concluded no material available is better than brass, with proper lubrication.
Window Barricade Material 13	Department of Housing and Community Development	GSFC and ad hoc group	Same solutions at Baltimore--try a new masonry nail.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Computer Graphics 14	Department of Planning	Golden; HUD, NSF, Charlotte, N.C.	Information on Charlotte, N.C. integrated municipal information system given to Planning Department for evaluation.
Culture Transporter Tests 15	Department of Public Health	GSFC Engineering Applications Branch	Tests by GSFC showed thermal boxes using fused salts had design deficiencies within required range. Should continue use of battery-powered boxes.
Digital Traffic Control/Emergency Vehicle Routing 16	Department of Transit and Traffic	Golden	Awaiting installation of new traffic control system.
Fire/Smoke Detection Devices 17	Fire Department	Golden	Discussions with National Bureau of Standards ; no further action.
Fire Station Location 18	Fire Department	Robert W. Nelson, GSFC consulting with Johns Hopkins and Department	Department has contract with Johns Hopkins for study; provided information and data to Johns Hopkins and city. Priority problems at GSFC.
Insecticide Technology 19	Department of Housing and Community Development	Golden; Dr. Eugene Wood, University of Maryland	Wood is working with the Department and established pilot program.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Landsat Data Utilization (Part of Water Quality) 20	Public Works	Golden; GSFC Data Collection Branch	Department has contract with General Electric, also has experiment (DCP) with GSFC/Wallops help; information to Regional Planning Council.
NASA Program Management 21	Department of Planning, Public Works	GSFC, Systems Development and Analysis Branch, and Administration and Management Directorate	Discussions, Baltimore personnel participated in NASA mini-pert. classes. Baltimore selected IBM systems.
Science Education Assistance 22	Department of Education	GSFC Educational Programs Office, Elva Bailey	Discussions--Baltimore Engineering Society is undertaking this as a project.
Silt Utilization Techniques 23	Department of Recreation and Parks, Housing and Community Development, Public Works	Golden, Hitman Associates, Army Corps of Engineers	Cost studies by departments involved are in process, conducted assays of silt.
Trash Vehicle Routing 24	Public Works, Department of Planning	Golden, GSFC	Sanitation Information Systems must be limited, but implementation problems with SIS of a political/management nature. Dropped.
Water System Simulation (Part of Water Quality) 25	Public Works		Early stages, appears feasible, collecting information from SIE for evaluation.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Algae/Nutrient Detection (Part of Water Quality) 26	Public Works	Golden, Johns Hopkins, (See Landsat Data)	Part of Data Collection Platform.
Bridge Safety Inspection 27	Public Works	Golden	Technology reviewed, but not operationally applicable. Dropped.
Char/Ash Separation 28	Public Works	Golden;AIAA Baltimore Chapter	Baltimore Chapter of AIAA is preparing a report for DPW recovery of energy and materials at pyrolysis.
Child Health Information System--Public Health Workshop 29	Health Department	Golden, GSFC on Workshop	Discussions lead to recognition of need to address nature of public health mission--workshops project.
Firescene Communications 30	Fire Department	Golden	Discussed but dropped, not useful.
Gasoline/Water Emulsion 31		Golden, Jesse Madey	Monitoring work at Oklahoma unit and tests at MIT; reserve recommendations pending test completion.
Incinerator Energy Conversion 32	Public Works	Golden, Planning and Programming, Facilities Engineering	Conducted consultant study and provided results; also waiting further R&D on heat pipes.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Laser Building Cleaner 33	Public Works	Golden;Boyle, Laser Technology Branch	Discussions--does not appear promising.
Lead Paint Detection 34	Department of Health	Golden; NASA, Elkins Dable, GSFC, Dr. Jacob Tromble, Spectroscopy Branch	Discussions suggested that NASA lightweight model not sufficiently advantagous to replace existing detectors. Dropped.
Methane Recovery 35	Department of Hospitals, Public Works	Golden, GSFC Planning and Programming Branch	Consultant study shows feasible, but treatment plant retrofit must wait pending changes in plant/ operation construction to meet EPA and state requirements.
Modular Integrated Utilities System 36	Planning Department, Housing and Community Development	Golden; JSC	Discussions, plans for first phase Coldspring too advanced for application. No further action.
Municipal Information Data Base 37	Office of Telecommunications, Department of Health	Golden	Low priority, included as part of Health Workshop.
Police Location System 38	Police Department	Golden, GSFC	Technology not available to meet vertical and horizontal location.
Pollution Situation Center (Part of Water Quality) 39	Public Works	Golden, EPA	Discussions with city and EPA officials; pending.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Rapid Bacterial Detectors 40	Health Department	JSC	Dropped as of September 1975, determined that a unit was under commercial development and to be announced in six to nine months. City and Johns Hopkins hospitals to be informed when ready for marketing.
Rat Control Experiments 41	Health Department	Golden; Edgewood Arsenal; Center for Defense Control	Discussions revealed lack of funding and priority in HEW to pursue new control substance. Dropped.
Satellite Communication Link Test 42	Police Department		Dependent on other tasks, too low priority in city. Dropped.
Sludge/Pyrolysis/ Thermoradiation 43	Public Works	JPL, ERDA	Tests underway in Albuquerque, N.M. Data to be available from there; shifted to "wastewater treatment techniques."

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Solarization Experiment	Department of Education, Housing and Community Development, Department of Planning	Golden, Hymowitz, Firehouse	
- Sharpe-Leadenhall School			- proposal (w/GE) for solar heating/ cooling for Sharpe-Leadenhall, proposal unsuccessful.
- Solar assisted hot water heating			- put together proposal for Westport demonstration on solar hot water.
- Upton Center Solar Heating & Cooling Demonstration			- with/architect (Wm. Potts) and engineer (Mueller Associates) made proposal to ERDA for solar heating of Upton Center, project was funded.
- Convention Center Solar Energy System			- Briefed convention center planners, no further action.
- Baltimore Aquarium 44			- Studied. Dropped.
Street Sweeper Concepts 45	Public Works	Golden, Jim Mills, Facilities Engineering Division	Plan a "brainstorming" session between DPW and GSFC officials, some developments in Europe. Pending.
BOD/Heavy Metals Detector (Part of Water Quality) 46	Public Works	Golden	Developing instrumentation for application.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Communication Systems Program - demonstrations, wired and unwired 47	Mayor's Office of Telecommunications	Golden	Feasibility study in a single department is being planned. (Health)
Other communications tasks - teleconferencing experiments - electronic displays and maps - high speed facsimile over phone lines 48	Mayor's Office of Telecommunications	Golden	Discussion lead to "test" case in Health Department--plan to hold workshop on communication and data problems in Department in cooperation with MOT. See #51.
Industrial Park Survey--Energy Conservation 49	Planning Department, Baltimore Economic Development Corp.	Golden	Discussions with ERDA, exploration of possible grant; potential for IR use to identify "energy leakage"--data provided for development of a proposal to ERDA.
High Rise Safety Workshop 50	Housing and Community Development	Golden, Mills and Wolff	Discussion, planning; workshop conducted 9/75; report issued in late fall, 1975.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Health Department Workshop 51	Health Department, Mayor's Office of Telecommunications	Golden, Mills, Wolfe, and Parker	Began in late 1975 planning for communication/information workshop on Health Department "needs"; feedback to #47.
Law Enforcement Technology 52	(Friedman) Mayor's Law and Enforcement Coordinator	Golden, GSFC Systems Development and Analysis Branch	Computerized criminal justice data; LEAA; continuing assessment of various systems.
Zinc Paint Tests 53	Public Works, Brad Blake, City Garage	Dr. John Schutt, GSFC	To paint on salt spreaders and cement mixers; applied in December 1975; evaluation continuing.
Data Collection Platform 54	Public Works, Jerry Valcik	Golden, Gordon, and Cote	Grew out of algae-nutrient detection (#26 and Landsat data). In process.
Hazards and Crisis Planning 55	Fire, Police, Office of Safety, Office of Disaster Control	Golden	Discussions re: risk analysis, handling dangerous materials; briefing on Risk Management System (KSC/NYC).
"911" Emergency Service 56	Fire, Police, Mayor, Berkowitz	Golden	"White paper" on pros and cons for Fire Chief, Police Commissioner, Mayor and Berkowitz. No further action.

Task Title	Baltimore Department/Agency	Goddard Involvement	Status or Disposition
Waterwaste Symposium 57	Public Works	Golden	Advice and assistance in preparing for DPW-sponsored one day symposium on advantages "state of the art".
Security Against Unauthorized Visitors in High Rise Housing 58	Housing and Community Development	Golden	In process of collecting information from knowledgeable sources.
Dealing with Senility in Public Housing Residents 59	Housing and Community Development	Golden	Collecting information/sources.
Dutch Elm Disease 60	Recreation and Parks	Golden	Literature and information provided department heads.
Renovated City Hall Attraction 61	Public Works	Golden	Information and sources supplied construction management heads and architect.
Baltimore Zoo Methane Recovery 62	Recreation and Parks	Golden	Probably not cost-effective, investigation will continue.
National Water Data Exchange 63	Public Works	Golden	Provided information to department heads.

APPENDIX D

Mini-Case Studies

In order to provide a richer depth of detail, especially to better reveal the nature of working level participation by Goddard scientists and engineers, five tasks were selected for more detailed exploration: (1) incinerator energy recovery, (2) data collection platform, (3) insecticide technology, (4) Health Department Workshop, and (5) solarization experiments.

The five were selected, not because they were "representative" of the 69 plus tasks, but because four of the five provided a means to better explore Goddard participation, and all promised data access lacking in many of the other tasks.

No single pattern prevails among these five mini-cases. They do reveal a persistence--both by interested Baltimore officials and by those providing outside assistance --to seek solutions which can prove effective and acceptable. None sought or achieved great visibility, though several were noted by the local press.

Mini-Case Studies

Incinerator Energy Recovery Task

This task involved investigating different techniques to make use of "waste" heat from city trash incinerators, specifically, reviewing potential applications of the Pulaski Highway Incinerator in Baltimore. The task was initiated when Charles L. Benton, Director of Finance for the City of Baltimore, wrote to the Mayor in June 1974, suggesting that NASA (under the BAP) be asked to look into the question of the potential use of waste heat at the city incinerators. [Benton had been asked by the Mayor to monitor solid waste disposal problems in the City.] The letter was relayed by the Mayor to Berkowitz who brought it to Golden's attention. Golden, who was aware of developments in heat pipe technology, saw this as a useful opportunity for applying Goddard technology in Baltimore. [Heat pipes were used at Goddard in developing space craft technology to equalize heating in space craft. The fundamental technology has been widely applied, including using heat pipes on the Alaska oil pipe line to maintain stable soil conditions.]

A group at Goddard in the Facilities Engineering Division had been working on a research project aimed at achieving a significant improvement in heat pipe technology. The research crew had run into a problem, giving this group some "slack time" so that they were eager to respond when Golden asked the team to have a look at potential applications of heat pipes for capturing waste heat in the Baltimore City incinerators.

On February 6, 1975, James Mills, Chief of the Facilities Engineering Division and James Robinson, Chief of the Planning Section, Planning and Programming Branch of that division, Golden, Dr. Walter Bienert and Mr. Allan Streb of Dynatherm Corporation visited the Pulaski Incinerator. During the visit this group did some informal calcuations which led them to conclude that a simple one percent efficiency recovery of waste heat could provide more than enough electricity to replace that being used by the incinerator plant--one possible use. It was the intention of the group at Goddard to "marry" the new generation of heat pipe technology, then under development, for application in the Baltimore incinerators. Unfortunately, the development was lagging; so, in order to meet Baltimore's need, the group decided to (as an interim measure) review more conventional methods.

Since the Facilities Engineering Division already had a group of engineering consultants under contract (Berger Associates of Harrisburg, Pennsylvania) a task order was issued in March 1975, for Berger Associates to conduct a feasibility study of recovering energy from the Pulaski Incinerator. They were to produce a "thermal" model of the incinerator and to recommend conventional energy capture methods. An engineer on the Department of Public Works staff, Mr. Milton Reizenstein, worked with the consultants by collecting data from industrial concerns in the general area of the incinerator to determine the potential "market" for steam. The consultants reviewed this possibility as well as the application of this steam for use at a City hospital complex (some distance from the incinerators).

An interim report was delivered in the spring of 1975, and reviewed by the Department of Public Works. It does not appear economically feasible to use the steam at a location not immediately adjacent to the incinerator. The Goddard team concluded that one alternative might be the use of steam at the incinerator to generate electricity for the incinerator. In cooperation with officials of the Department of Public Works, Goddard officials will discuss the possibility of "trading" electricity generated at the plant with the Baltimore Gas and Electric Company (which might actually operate the generating equipment). As the research in improved heat pipe technology progresses, Goddard will maintain close contact with the Baltimore Department of Public Works and continue to review the possible incorporation of heat pipe technology in new incinerator construction within the City.

Data Collection Platform

This task is an experiment to determine if fresh water quality in a reservoir supplying the City of Baltimore can be monitored remotely using the Landsat satellite. The task was started when Fred Gordon of Goddard's Mission Utilization Office, Applications Directorate, suggested to Tom Golden that some use might found in Baltimore for ocean platforms which have been used for remote sensing in a global atmospheric test program. It was Golden's opinion that there was a strong possibility these platforms could prove useful. Golden checked informally with a number of Baltimore officials, and it was determined

that there was a willingness on the part of the officials at Wallops to cooperate by making several of these instrumented platforms available. During the late fall of 1975, a meeting was held with officials from the Bureau of Operations in the Department of Public Works (Gene L. Neff headed the Bureau at that time) with Walter J. Koterwas, Chief of the Division of Water, Richard J. Kretzschmar of the Water Engineering Division, and Jerry A. Valcik, Chief of the Water Quality Section. Goddard officials attending were Golden, Fred Gordon, Charles Cote, Head of the Data Collections Systems Branch in the Communications and Navigations Division and his colleague, Dr. Earle Painter.

The problem which the Public Works officials wished to tackle was monitoring water quality in their Loch Raven reservoir. This reservoir was of particular interest because it was showing early stages of eutrophication, and they wished to chart key changes which occur over various seasons as well as to monitor an experiment which calls for aerating about 15 percent of the reservoir immediately above the dam. Principal interest by Baltimore officials was to monitor water for dissolved oxygen, temperature, and pH factor. The Data Collection Platform (DCP) carried instrumentation to measure dissolved oxygen, temperature, depth, pH, salinity, and conductivity. (Since the probes were designed for use in seawater, clarity (transmittance), and conductivity parameters would be virtually useless to determine changes in fresh water or dissolved salts.)

In January 1976, Jerry Valcik, and a technician, visited Wallops Station to receive an informal briefing on the equipment involved in the

platform (antennae, the instrumented probe, power supply, signal receiving/generating equipment). They picked up three complete platforms and brought them back to Baltimore to prepare for installation.

An important aspect of this experiment was the communications link from the platform to the Landsat satellite; from there to a receiving station at Goddard Space Flight Center where the data would be partially processed, with the print-outs being sent from Goddard to the Department of Public Works for analysis. Since a communications link from the platform to the Landsat was part of the experiment, Golden formally requested, by letter, permission to use this link as an official task of the BAP on February 3, 1976. On February 19, 1976, the loan of the three data collection platforms by Wallops Station was made formal by a memorandum and an equipment voucher assigning the platforms to the Baltimore Applications Project and subsequently released to the Baltimore Department of Public Works. At the end of February, the Assistant Administrator for Applications at NASA Headquarters sent a letter to the Director of Goddard asking several questions about the experiment in order to resolve the approval of the communication link with the Landsat. Golden had been assured informally that the work should continue on this experiment. Charles Cote developed a memorandum answering the questions, and this was forwarded through the formal Field Center channels to Headquarters. The approval for the Landsat link had not been completed by the end of June 1976, and some impatience was developing among those involved at the Department of Public Works. Therefore, the Head of

the Bureau of Operations (Gene Neff) sent a letter to NASA Headquarters on July 1, seeking final approval for the DCP experiment. Formal approval was forthcoming by letter of July 28, 1976 and the experiment proceeded.

By late summer one of three data collection platforms had been installed and was being calibrated with the assistance of Walter Allen from Goddard. Allen made several trips to Baltimore in the process of assisting in testing the platform. By September, data from the platform was being received in Baltimore. Data was being checked to determind the reliability of the instrumentation and possible need for additional calibration or adjustments of the instruments. Plans were being developed to computerize the analysis at the Department of Public Works so that raw data (using punched cards) could be used directly. If the experiment proves successful, there is hope that a data link may be established to provide "real time" data from the Landsat to Goddard and then to Baltimore. This would permit testing different arrangements of the DCP, such as placing one in the Susquehanna River water intake to check major variations in water quality at that point. Consideration also is being given to determining the feasibility and the desirability of purchasing or seeking the development of probe instrumentation which would be more directly applicable to a wide range of fresh water parameters of interest to the Department of Public Works and the water utility industry in particular.

Insecticide Technology

This task began with a telephone call to Tom Golden during the summer of 1974 from VanStory Branch, Director of Housing Management in the Department of Housing and Community Development. He asked Golden to look into the problem of maintaining effective roach control in public housing units. Golden contacted several acquaintances in the Agricultural Research Service, and after several conversations, was lead to Dr. F. Eugene Wood, Extension Entymologist in the Department of Entyomology, University of Maryland. Wood was invited to meet with VanStory Branch and other officials in Baltimore about this problem. From that point on, Wood took the initiative. Branch assigned Mr. Clyde Frasier, a landscape architect responsible for exterior maintenance in the housing projects,as his liaison for the task. Although pest control does not come under Frasier's responsibility, he was assigned because he was the most knowledgeable person in Branch's division who had experience in dealing with chemicals, such as pesticides. With Frasier as his principal liaison with the Department, Wood began to work closely with pest control crews, reviewing their procedures and providing them with special training in the handling of pesticides to include both effectiveness and safety.

There was an almost immediate, noticeable improvement in the morale of the control crews. It should be remembered that pest control crews are not welcomed by the residents of public housing units because they are visible evidence of a "social" problem. Some residents refused

scheduled treatment visits, and even went so far as to obtain a "doctor's excuse" claiming a sensitivity to pesticide chemicals. This put something of a social stigma on the crew, as well as providing harboring areas for roaches while spray is being applied elsewhere.

Wood also worked with a specialist in nutrition education to improve residents' domestic habits which could improve better health and roach control. Wood developed an extraordinary rapport with both the control crew and with most residents in the developments where he worked.

Wood became increasingly concerned about the lack of effective pesticides, attacking the problem in three ways: (1) by trying new chemical agents, (2) by continuing the crew's training; and (3) by working on the problem of non-compliance among the residents through meetings and educational efforts in cooperation with the nutrition specialist. Wood sees some evidence that the roach population in the Baltimore Public Housing Units, because of the combination of "regular" spraying and considerable "non-compliance", has become largely immune to most pesticides, having incorporated into the genetic material (and/or behavior) capacity to survive most chemicals normally used. Wood would like use this opportunity in Baltimore to conduct a series of observations and experiments, ultimately leading to better means of control.

VanStory Branch and other officials have been pleased with Wood's operation; however, Wood believes that he is rapidly approaching

a "moment of truth". His recent experiment using different chemical agents, has not proved particularly successful in controlling roaches, and he believes that the roaches may have developed a cross-resistance, making them very difficult to control--in fact, he has as much predicted a "roach explosion" within two years if improved control mechanisms are not developed. In addition, he is frustrated at his inability to obtain any kind of "reward" from the department for the fine work by his crew--he attempted to obtain uniforms to give them some visual recognition (as well as easier entrance into the housing units), but this was turned down by the Department.

There also appears to be some communication problem at the supervisory levels about the crew in terms of an understanding and acceptance of what Wood is trying to accomplish. Thus far, he has been unable to penetrate the supervisory structure to produce a "permanent" change in the pattern by which roach control is applied--crews are still assigned according to a mechanical schedule of spraying, rotating through the various departments, without any priority based upon the differing, particular needs of the various units--some of which might still be amenable to relatively simple preventive treatment. [In fact, it was at least partly due to the "regular", but ineffective, spraying that permitted the gradual accommodation of the roach population, building a resistance to the chemicals being used.]

Although this task has been widely viewed as most successful, it has reached a point at which intervention is necessary or the task

appears to be in jeopardy, possibly eliminating important potential gains of both a practical and an experimental nature for roach control in urban areas.

Baltimore Health Department Workshop

This task had its genesis in a series of discussions between Golden and Dr. Marvin Rimmerman, Director of the Mayor's Office of Telecommunications. Rimmerman had asked for Golden's assistance in surveying a variety of communications problems and/or opportunities in the City of Baltimore. Rimmerman was especially eager to undertake practical demonstrations of telecommunications technology applicable to the City departments. Concurrently, Golden had been discussing, with the Commissioner of Health, a variety of his concerns, one of which was a modernized communication and information system for the department. Both the Commissioner of Health, Dr. John DeHoff, and Rimmerman had participated in a workshop which brought a variety of City officials and experts together to explore questions involving high rise housing for senior citizens. Based on that experience, DeHoff and Rimmerman believed it would be useful to use the workshop technique as the first step in exploring a possible demonstration of communications/information systems technology for the Department of Health. The purpose of the workshop was described as,

> The type of function foreseen for the Workshop is one of bridging the gap between two areas of specific knowledge. The Workshop technique can, hopefully, provide the means of dialogue where user requirements and technical system descriptions can be melded. At

> the same time, to some degree at least the administrative and operating requirements of the Department can be adapted (streamlined) to fit the new capability.*

Initial planning scheduled the workshop for April 1976. Dr. Edward Wolff, Deputy Director of the Goddard Communications and Navigation Division agreed to work with DeHoff and Rimmerman in the planning and to conduct the workshop. Wolff had considerable experience in conducting workshops of a developmental and educational nature at Goddard where technical and managerial problems were involved. Although the workshop was to be sponsored under the auspices of the Department of Health, Rimmerman took the responsibility for arranging the participation of several communications experts from the Department of Commerce. As the planning with DeHoff and senior staff of the Department of Health progressed, it became more apparent that the departmental goals and philosophy and their relationships to organizational structure were inadequately defined and understood. Without clarification of these areas it would prove difficult to make a realistic connection with the technological side of improved communications and information systems. Therefore, over a period of weeks, the planning for the workshop gradually shifted toward a more searching look at departmental objectives and administration. This is reflected in the memorandum from the Commissioner to senior staff requesting nominations to the workshop,

> As you know, we have been planning an over-night one and half day workshop for 22-23 July at the Donaldson-

* Baltimore Applications Project, Interim Progress Report, December 1975, page 3.

> Brown Center in Port Deposit, Maryland. We began by considering ways to improve communication and administration through technology. It soon developed that the first need was to understand what goes on in these two Health Department modalities, and then go on to developing the technology for improvement. Therefore, the workshop will deal with health needs of the city and department modernization required to meet them. **
>
> The focus of the workshop then became an examination of . . .
>
> The state of the public health program in Baltimore and the resources needed. Through the workshop we will have a clear statement of the objectives for the Department; we will discuss problems in achieving these objectives. ***

Each of the thirty participants was asked to complete a list of: (1) health problems, and (2) organizational needs, submitting these in advance as list for discussion by the whole body and by the separate groups which were formed at the workshop. There was some concern about the "lack of structure" in the workshop, but those who participated concluded that it was a successful exercise, opening many doors, providing new opportunities for the exploration of these important issues throughout the department. At the conclusion of the workshop, it was the intention of the Commissioner to review the many findings and recommendations, then move to take next steps in redefining the goals and administrative arrangements to meet those goals.

** Memorandum from John DeHoff, M.D., Commissioner of Health, Subject, Workshop at Port Deposit, Maryland, June 7, 1976.

*** Memorandum from John DeHoff, M.C., Commissioner of Health, Subject, Workshop at Port Deposit, Maryland, June 22, 1976.

The one negative note in this task was that, as the final planning for the workshop moved along in the Department of Health, apparently Rimmerman was not kept informed about the shift in emphasis. He was mildly disgruntled at not being invited until the last moment, as well as having the tentative arrangements he made for bringing in federal attendees shortcut.

Solarization Experiments

Five separate tasks can be included under the general title of "Solarization Experiments",: (1) the Sharpe-Leadenhall School, (2) solar-assisted hot water heating, (3) Upton Center solar heating demonstration, (4) convention center solar energy system, and (5) Baltimore aquarium solar energy demonstration. Two of these will be discussed in some detail--the Upton Center solar heating demonstration project and the Sharpe-Leadenhall School project.

From the beginning of the BAP, Golden was convinced that the whole area of energy and energy conservation held substantial potential for innovative applications. Golden engaged in a series of discussions with Berkowitz on emerging projects in the City's capital construction plans to determine where there might be a potential for demonstrating solar energy applications. Concurrently, he arranged a series of educational sessions to develop a better understanding of solar energy and its possibilities among officials in the City. In this he was considerably assisted by Mr. Emil Hymowitz of the International Projects

Office in the Engineering Directorate at Goddard. Hymowitz had extensive experience in spacecraft technology and had taken over responsibility for directing the Greenbelt Solar Demonstration Project--a local demonstration of solar energy applied to domestic heating and domestic hot water use. Arrangements were made to bring in engineering consultants, specialists from industry, and experts from Federal agencies to provide briefings, discussions, etc. for City officials. Field trips to Goddard Space Flight Center, several industrial sites, and to other Field Centers were arranged to provide first-hand contact on the part of City officials with research and demonstration in solar energy.

During the review of potential construction projects, Berkowitz and Golden identified two as being likely candidates for solar energy application--the Upton Multi-Purpose Center and the Sharpe-Leadenhall School. The first involved the planning and development of a City service which incorporated a number of City functions to serve a particular neighborhood. The Upton Center was in the stage of architectural-engineering work permitting "intervention" and the nature of the building and its location suggested that it would be a good candidate for the kind of solar application demonstration which might earn a grant from the Federal Energy Research and Development Agency. (Golden had alerted City officials to the fact that both the ERDA and the Department of Housing and Urban Development were

offering a series of Federal grants for demonstration projects to conserve or make innovative demonstration projects in the areas of solar energy.)

Golden worked closely with officials of the Planning Department and the Department of Housing and Community Development which have a joint responsibility for the Upton Center Project. In addition, he brought together officials from the Department of Public Works who had a monitoring function and put them in touch with the engineering consultants, Mueller Associates, Inc., who had been retained by the architect responsible for designing the Upton Center. The two engineers responsible from Mueller were Andrew J. Parker, and Robert E. Hedden. Parker and Hedden agreed that the Upton project was a good candidate for a possible demonstration project and suggested that, of the various alternatives available among ERDA programs, the City try for a PON (Program Opportunity Notice) type of program which involved a shared-cost grant. Golden played principally a liaison function in the development of the actual grant proposal, working with the engineering consultants and representatives of the City agencies involved. From the viewpoint of the consultants, it was especially helpful in "shepherding" the project through the necessary City channels. Goddard engineers assisted through computer "modeling" during the design phase. From the viewpoint of the City officials, Golden provided technical assurance and made available information of an understandable nature that could keep them current with the state of planning and progress.

The grant proposal proved to be successful with the City being awarded the grant, Bernard Berkowitz acting as the project manager for the City on the project. The project is expected to be completed by early 1977.

The Sharpe-Leadenhall School represents another attempt to win a Federal grant for a solar energy demonstration project. In this case, Golden worked closely with the engineers/architects for the school (the solar demonstration being only one part of the construction project), with the Assistant Superintendent for Physical Plant, Curtis Lantz, the school architect, Grinnell Locke, and with two representatives of the General Electric Company, William Terrill, and William Moore. This task involved an innovative approach by which solar collectors on the roof of the school would be incorporated into the roof design and support system, rather than being merely an "add-on" to the roof. Like the Upton project, Golden acted principally as a liaison agent arranging for briefings and meetings at which information was made available to City officials, facilitating the interaction of General Electric representatives with the engineers/architects and school officials. A number of representatives from Goddard assisted, providing "back-up expertise" during the preparation of the proposal.

Unfortunately, the Sharpe-Leadenhall project did not receive an ERDA grant--Golden believes, because the proposed design was more risky that ERDA wished to chance in a program where it was hoped the demonstration would be not so much experimental but successful, encouraging further and rapid application of solar energy technology.

One of the principal reasons for undertaking these various tasks in solar energy, from Golden's viewpoint, was to give City officials confidence in how to specify technologically more sophisticated products--particularly within an area which has considerable potential for growth in the future.

APPENDIX E

Persons Interviewed

Appendix E

Persons Interviewed - Baltimore

Department of Public Works

Edward Bochenek, Chief, Technical Services
Sam Cortese, Highway Management Division
Walter Koterwas, Chief, Division of Treatment & Pumping, Water Supply
Richard Kretzschmar, Chief, Water Division, Engineering
Francis W. Kuchta, Director
Eugene Neff, Deputy Director, Public Works Department, County of Baltimore, (formerly Head, Bureau of Operations, Department of Public Works, Baltimore City
H. Singh Patheja, Public Works Engineer
Martin Reizenstein, Division of Waster Water
William E. Riley, Head, Bureau of Engineering
Jerry Valcik, Chief, Water Quality Section

Housing and Community Development

VanStory Branch, Director, Division of Housing Management
Jay Brodie, Deputy Commissioner
Robert Embry, Commissioner
Larry Merrill, Project Scheduling Coordinator

Mayor's Office

James Beek, Assistant Press Officer
Bernard Berkowitz, Mayor's Coordinator for Physical Development
Marvin Rimmerman, Director of Telecommunications

Fire Department

Thomas Burke, Chief

Department of Education

Curtis Lantz, Assistant Superintendent of Physical Plant

Department of Planning

Victor Bonaparte, Upton Center Coordinator
Sydney Brower, Chief of Planning Section
Neil Curran, Chief, Economic Analysis Section
Sheldon Lynn, Deputy Director of Planning
Larry Reich, Director

Parks and Recreation Department

William Bunn, Chief Engineer
Douglas Tawney, Director

Health Department

William Dahle, Director, Industrial Health
John DeHoff, Commissioner
James Rhyne, Deputy Commissioner

Department of Transit and Traffic

Hugo Liem, Commissioner
Norbert Nitsch, Jr., Assistant Commissioner

Persons Interviewed - GSFC/Others

BAP Project Office

Jack Peake, Director
Tom Golden, Project Director

GSFC Director's Office

Donald Hearth, former Deputy Director

Administration and Management Directorate

Charles Boyle, Chief, Special Programs Officer
James Robinson, Chief, Planning Section, Facilities Engineering Division

Applications Directorate

Walter Allen, Mobile Radio Determination Branch,
Edward Wolff, Associate Chief, Communications and Navigation Division
Fred Gordon, Missions Utilization Office
Charles Cote, Data Collection Systems Branch, Communications and Navigation Division

Technical Utilization Office

Donald Friedman, Chief

Engineering Directorate

Emil Hymowitz, Program Director, ANS, IRAS Greenbelt Projects

University of Maryland

F. Eugene Wood, Extension Entymologist

Police Department

Major Ronald J. Mullen, Director of Planning and Research
Major Robert Norton, Director of Communications

Baltimore City Hospitals

Walter Williams, Division of Hospital Services

Mueller Associates, Inc.

Robert E. Hedden, Program Manager, Energy and Environmental Systems
Andrew J. Parker, Vice President